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Journal of the Northern California QRP Club

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From the Editor

by Doug Hendricks, KI6DS

This issue has some excellent articles, including a long one on "How to make a CW contact" by Jack Waggoner, WB8FSV. You might wonder why I would devote so much space to an article like this. The answer is that it is very valuable information and is especially valuable to the beginners out there. We must always keep in mind that we are always attracting new people to QRP. That is the life blood of our hobby.

Also, we have another in the series of Blue Printing QRP rig articles by Gary Surrency, AB7MY. Gary is the best that I know for writing articles on tweaking rigs. If you have a NorCal 20, be sure to read this one plus the one on page 57 by Dave Meacham, W6EMD. They will make a great rig even better.

Check out a couple of timely articles by a new author to QRPp, Jay Bromley, W5JAY.

And finally, I am most pleased that we have Paul Harden's QRP Hints and Kinks back again. He has a couple of extra pages this issue. Those begin on page 61 and are wonderful as always. Have a good fall and get on the air and make contacts. 72, Doug, KI6DS

CW Offset Tone Decoder

by Jerry Henshaw, KR5L
Address Needed
City, State, Zip
jhenshaw@bellsouth.net

This circuit was designed for those of us who are tonally challenged when it comes to zero beating with another CW station. My K2 has a built in "Spot" feature that allows you to zero beat with a station of interest. Although the Spot feature works well, I am almost tone deaf so it is of little help to me. I have posted this little circuit on the Elecraft reflector and there has been a very good response. Peter Zenker has asked to publish the circuit in the German QRP newsletter. Additionally, it has been pointed out that FISTS has published a similar circuit in their newsletter. The circuit presented here is my own original design — heck, there are probably better circuits but mine works great for me.

Tom Hammond, N0SS, took it upon himself to layout a PC board for the circuit and has kindly given me his permission to publish it here. Thanks Tom, your generosity is greatly appreciated.

The design is based upon a PLL Tone Decoder IC. I used a NTE832 substitute for the more popular NE567. I was unable to purchase a real NE567 locally so I used the NE832. I haven't had the opportunity to verify that a NE567 will work in my circuit.

The component values in this circuit will allow you to set the center frequency (CW side tone note) from about 350 Hz up to over 1 Khz, which should be adequate for most users. The LED "lock" indicator has a 1 K resistor in series with +VCC thus setting the current at 8ma (at 8 volts). The spec sheet says VCC can be anywhere from 5 to 9 volts. You can increase the value of the 1K resistor to lower the LED current if you so desire.

I plan to mount a subminiature LED or SMD LED in the "Rate/Lock" button on my K2 to indicate a "Lock" condition.... Kinda appropriate don't you think? This mounting scheme doesn't require drilling any holes in the K2's front panel (horror of horrors). If I want to return the K2 back to its "factory original condition", all I have to do is replace the key cap.

The center frequency of circuit is determined by the 5K trim pot (at least 10 turn pot), 2.2K resistor, and the .47 uFcapacitor. Be careful in selecting the .47 uFtiming capacitor. The stability of timing capacitor determines the stability of the free running center frequency oscillator. In my case I used a Mouser # 581-470NK63 metallized polyester film capacitor. The oscillator has remained stable at 650 Hz (my CW offset frequency) within 1 cycle over the course of several days.

I used a 100 uFelectrolytic to couple the audio from my rig to the circuit. A 10 uFwould probably work just as well. I used 10 uF and a 22 uFelectrolytic capacitors (from my NORCAL capacitor kit) for the filter capacitors. Tom Hammond laid out the PC board for two tantalum caps. If you use electrolytics, please make sure the negative leads go to ground and the positive leads go to the IC pins 1 and 2.

The lock range on the circuit is plus or minus 20 Hz of the center frequency. It is very easy to "rock" the tuning knob a few degrees and watch the LED go on and off then simply stop in the center of the on/off range. This is very easy to do in practice. You can tighten up the bandpass filter by increasing the 10 uFand 22 uFcapacitors. The ratio of the value of the two capacitors should be at least 2:1 , 3:1 may be even better. I used the values of capacitors that were available in the NORCAL capacitor kit.

What is amazing, at least to me, is the circuit's ability to dig tones out of the noise. The little circuit is listening for a very narrow audio spectrum and is very good at differentiating the tone from QRN... very impressive. Not my circuit, the tone decoder chip.

I used a frequency counter attached to pin 5 (Timing Resistor) to measure the center frequency. You really need a good quality 10/15 turn trim pot to accurately adjust this frequency setting. An alternative method is to key your transmitter into a dummy load feed the audio (I used the headphone jack) to the circuit and adjust the trim pot until the LED lights up. Use this method if you don't have a frequency counter. You must adjust the trim pot very slowly to allow the PLL to lock on your side tone with each slight rotation.

The circuit will indicate a lock after 2-3 dits at 25 WPM. I had my prototype set up on the bench with a long test lead attached to my bench power supply. In this set up, my circuit would pick up RF from the transmitter and NOT indicate a lock during transmission. So keep your leads short or use a 9 volt battery if you use the circuit in an external fashion. By the way, the built in hysteresis of the circuit will NOT let you copy CW by watching the blinking LED!!!

I built my prototype on a R/S universal PC board. I used simple point to point wiring. The entire circuit fits within a 1 inch square. I used a R/S "Y" connector at my headphone jack to couple the audio into the tone decoder. The circuit requires a "normal" audio level for detection – the general rule is if I can copy the signal by ear, the circuit can detect it as well.

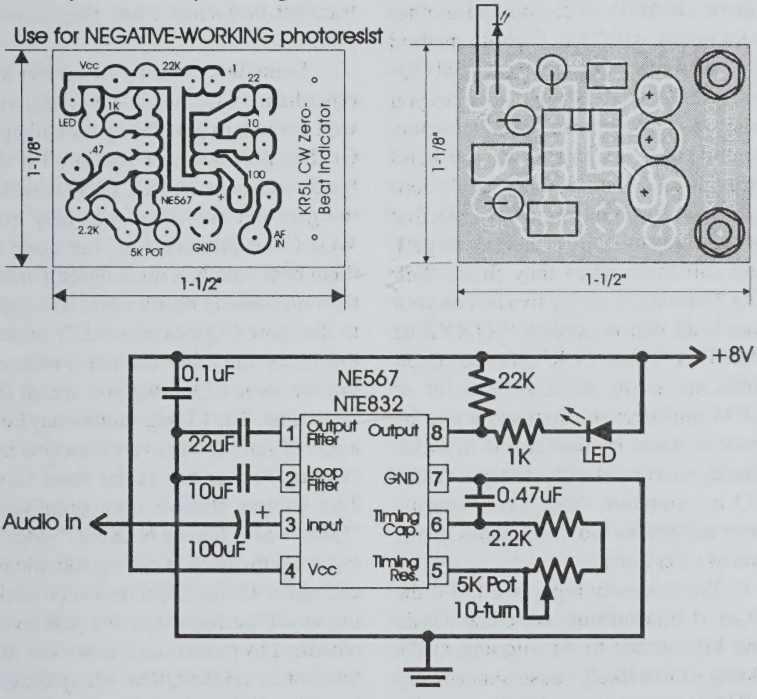
I plan to mount this circuit (yes my prototype board) inside my K2 as soon as my order for replacement key caps come in. Right now I use it on the bench and it works great. I am amazed how badly I can recognize tones by ear. I have thought on several occasions that the circuit wasn't working properly because I tuned in a station using my "ears" and the LED was doing nothing, zip, zero, nada. But lo and behold, I turned the tuning knob a few degrees and suddenly the LED was merrily blinking away indicating a lock. I tested the circuit by switching between CW N and CW R. There was little or no tone difference between these settings indicating I was zeroed in on the station. I would have been way off if I had relied solely on my ears for a zero beat!

The present circuit draws about 25ma with the LED turned on (with a 1K current limiting resistor). It draws about 17 ma while in "listening only" mode. I have ordered a CMOS version of the NE567, which uses 1/10 of the current of the original chip. The frequency determining components are one half the value of the original circuit (.47uFbecomes .22uf) and the bandpass caps are considerably smaller as well. Tom Hammond's PC board should still be okay as the physical size of the parts

should remain the same. Homework assignment — build a CMOS version of this circuit and let us all know how well it works. I plan to build one as soon as my CMOS chips arrive.

So if you are tonally challenged and need a little help in zero beating a CW station, give this circuit a try. If you build one, please let me know if your results compare with mine.

72's, Jerry Henshaw, KR5L



Specialized Parts available from Mouser (www.mouser.com)
0.47 Metallized Polyester Film, 581-470NK63 ($0.67)
0.1uF Monolythic Ceramic 581-UDZ104K1 ($0.31)
10 uF 16V Tantalum, 581-10K16V ($0.50)
22 uF 16V Tantalum, 581-22K16V ($0.73)
100 uF 16V Electrolytic, 208-16V100 ($0.39)
5K 12-Turn Top Adjust Pot, 594-74W-5K ($2.25)
NE567 DIP-8 tone Decoder/PLL 513-NJM567D ($0.38)

Note: The diode orientation is correct in the schematic, the parts over lay has it reversed. Please be careful if you build the circuit.

A Beginner's Guide to Making CW Contacts

by Jack Wagoner WB8FSV

Finding Someone To Talk With Answer a CQ

How the heck do you begin a CW conversation? How do you find another ham to talk with? My favorite method is to **answer a CQ**. Sending several CQs followed by your callsign indicates you want to start a contact with someone. Simply tune up and down the band searching for that familiar "CQ", zero beat your transmit frequency with that of the CQer(or as close as you can get), and call them when they finish their CQ. Normally a one by two call on your part is all that is needed, "N1XYZ de WB8FSV WB8FSV K". If band conditions are poor, or there is a lot of QRM(interference), perhaps a two by three or a one by four call is in order. One by two initial calls in response to a CQ are common these days, sending your call letters too many times marks you as a beginner.

Please do not reply to a CQ if the CQer is transmitting too close(within one kHz or so) to an ongoing QSO. Doing so will likely cause unnecessary QRM to the ongoing QSO, you may even drive them off the air. Not cool. Common ham courtesy says do your best not to cause unnecessary QRM. Occasionally I will hear a CQing station that I would really like to answer, but the CQer is too close to an ongoing QSO, as I mentioned above. The best thing would be to not answer the CQer, but I have been know to answer the CQer at least one or two kHz away from the CQers frequency. My hope is that they will hear me and move their transmitting frequency to mine. Then I can have my contact and not cause QRM to the ongoing QSO. Sometimes this works, but likely the CQer will not even hear you, or will not change their transmit frequency when they answer you.

Sometimes when you answer another ham's CQ, they may not hear you well enough to get all of your callsign. Or they may not hear you at all if the band conditions are bad. There is such a thing as one way skip: you may hear West Coast stations fine, but none of them hear you. Not uncommonly more than one station besides you will reply to the same CQ that you did. You may even hear the other station(s) answering the same CQer that you are, at the same time. The CQing station may hear a mixed jumble of several stations answering him or her at the same time. The CQing station may then send "QRZ?" or "QRZ de N1XYZ?" Meaning, who the heck is calling me, please call again. Or the CQer may send nothing at all, perhaps they are just overwhelmed by more than one answer at a time, or by all the QRM. Many times I have found that if a CQer does not respond to my first reply and I hear only silence, if I call him(or her) again, they may well return to me.

Not uncommonly, when you begin to reply to another ham's CQ, you will hear other stations besides yourself calling the CQer at the same time that you are. I usually continue transmitting and then see if the CQer answers me or one of the other stations. If the CQer chooses you over the other stations, you can assume your signal was likely stronger or more interesting. If you do not have a competitive na-

ture, then stop transmitting as soon as you hear other hams answering the CQer. Let them have the contact. Should you really want to make the contact yourself, continue calling and then drag out your call by sending your callsign once or twice after you hear the other answering station(s) finish their call. This trick, often used by DXers, sometimes works. Also, if while answering a CQer, you hear the CQer return to another different station, stop transmitting. You lost. Continue your search for another CQer. If you **really** want to contact this CQing station you could simply wait for them to finish their current contact and then tailend them.

Occasionally as I scan the band looking for a CQ to answer, I may come across a ham sending their callsign two or more times, before they sign, "N1XYZ N1XYZ K". I believe it is safe to assume this ham has just finished sending a CQ, and often, if I like their callsign, I will listen a second, then go ahead and call them. Since I heard only their callsign and not the actual CQ, it is possible that this is **not** a CQ(maybe they were calling another ham instead). Listen a few seconds to ensure you are not interrupting a QSO, then assume that it was a CQ. I have found that sometimes if I wait for this suspected CQer to send another separate CQ, by that time they will have attracted a few more replies to their CQ, and I may lose out on what could have been a good contact. In the same regard, you may be in contact with another ham and end one of your transmissions by sending your own callsign two or more times(perhaps you repeat your call a few times because the other ham has copied it wrong). Then as a result, in the middle of your contact, you may be called by a third ham, who incorrectly assumes you have called CQ. Simply ignore the interrupting third ham.

When answering a CQer you should zero beat the other ham's frequency, or set your transmit frequency as close to theirs as possible. Many hams today, in order to deal with the increasing QRM, make use of very narrow receive filters. The CQer may have their narrow filter turned on and not hear you answer if you are more than a few hundred cycles away from their transmit frequency. This is a quite common occurance on the CW ham bands, and points to the importance of correctly zero beating with your ham rig. By the same token, should you be calling CQ, do so with your narrow CW filter turned off, or you may well not hear several answering hams. Many hams are uncertain how to correctly zero beat their rigs on CW.

If you are fortunate to have a newer transceiver that has dual VFOs, it can simplify your search for a CQ to answer. While scanning for a CQ, if you come across something interesting, such as someone tuning up(a potential CQer), a clear frequency(that you may wish to use later to call your own CQ), or an interesting QSO(that you might want to tailend when it finishes), then leave one of your VFOs on that spot. As you then continue scanning for a CQ, you can periodically, at the press of one button, switch to your second inactive VFO and see what's happening on your other interesting frequency. Having two VFOs built into your radio can greatly enhance the ease and convenience of your CW operation. Sometimes I wish my rig had three or four VFOs. HI. If your ham rig does not have dual VFOs, you can simply remember, or write

down, any interesting frequencies you come across while scanning.

Call Your Own CQ

Tuning around searching for CQs can tend to be frustrating. At times there just don't seem to be many folks calling CQ, and the ones I do hear are jumped on by a much stronger or faster station than me. Never fear, there are other productive ways to find a CW contact. Obviously another method would be to find a nice quiet unused frequency and call CQ yourself. Before you fire up your transmitter and send a CQ, listen a few minutes to the frequency to ensure that you are not going to stomp on another conversation. It is very possible that another ham is transmitting on the same frequency but their signal is skipping over you. It is highly recommended that you send a "QRL?", or better yet send a "QRL de WB8FSV?" to see if the frequency is clear. Technically the FCC requires you identify each transmission, and an unidentified "QRL?" is frowned upon. Although everybody does it. Or, if you have the patience, an even better method is to simply listen to the frequency in question for at least 5 minutes. Even then I would still send a "QRL?" before I cut loose with my CQ.

An old fashioned and rarely heard equivalent of "QRL?" is "dit-dit dit", or the CW letters, "I E". It would be sent before a CQ to see if the frequency was clear. Just like "QRL?". The correct response is the same as that to "QRL?" If you happen to be listening and hear someone send an "I E", if the frequency is not busy the correct response is to say nothing or to perhaps send an "N" for "no". If the frequency **is** busy, like you are having a QSO on the frequency, the correct response would be to send a "C" or "yes". "C" is often used as a CW abbreviation for the word "yes".

If your CQ is answered by more than one station, usually the best practice is to reply to the strongest station. The strongest station is more likely to copy you stronger also, and you will be better able to copy each other should you both be attacked by QRM, QRN, or QSB. If you are able to copy the callsigns of both hams who answer your CQ, and the weaker station has a more interesting callsign, certainly you could answer the weaker/more interesting ham. Since the weaker station is answering your CQ, obviously they can hear you as well. Should two stations respond to your CQ, you can answer them both and try a three-way contact. Three-way contacts on CW are difficult to do.

Send your CQ at the speed you would like to be answered. A three or four by two call repeated twice should be sufficient, "CQ CQ CQ de WB8FSV WB8FSV CQ CQ CQ de WB8FSV WB8FSV K". There are many variations. You will hear some beginners sending 15 or 20 CQs before their callsign, not a good idea. If you scan the band and find it active and full of ham signals, a shorter CQ should work. At times when I know another ham is listening on the frequency(perhaps I just heard them tune up), I may get them to answer with a simple one by one, "CQ de WB8FSV K".

After sending your CQ you may get an instant response, or you may get no response at all. It may also take some hams a moment to respond to your CQ. They may need to tune up their rigs, zero beat your frequency, or take a few seconds to run to their desk from across the shack. These folks may answer you

five or ten seconds after your CQ. Be patient. After sending a CQ myself, I may tune around my transmit frequency a bit using my receiver's RIT(receiver incremental tuning). Because some hams may have trouble zero beating my transmit frequency correctly. Perhaps they are still using crystal control - not uncommon with homebrew QRP radios.

If I get no response after a couple 3 by 2 CQ calls, or I can tell there is very little activity on the band, I may then send a 6 by 2 CQ. The more CQs you transmit, the greater the chance that another ham scanning by will hear and answer you. I believe a pair of 6 by 2 calls is more than enough CQs. Should you still get no response to your own CQs, maybe the band conditions are just plain lousy, maybe you are transmitting too close to another QSO that you can't hear, maybe no one wants to talk to you. Try another frequency, try another band, listen for someone else calling CQ, or turn off the radio and go feed the cat.

Tailend Another QSO

A third major way to find someone to talk with on the ham bands is tailending. To tailend a conversation is to wait until another contact is completed, and then call the participant you want to talk with. This may work about half the time. Not uncommonly you will get no answer. The station you call is probably not expecting a call, they may have already turned off their radio, or may simply have something else to do. But sometimes tailending works. As you scan across the band looking for CQs or for a clear frequency on which to call your own CQ, you may hear an interesting conversation that you wish to contribute to, or you may hear a ham friend you want to say hello to.

The polite way to tailend another QSO is wait until the other stations are completely finished. This is easy to determine if you are able to hear both of the stations talking. But sometimes due to radio conditions you will hear just one of the stations. For example, you hear the end of a QSO between KH6XYZ and WB8FSV. You would like to work KH6XYZ and are unable to hear WB8FSV. When you hear the first station send something like, "HOPE TO CUAGN 73 WB8FSV de KH6XYZ TU K", wait. Wait a minute or two until the first station KH6XYZ acknowledges WB8FSV's last transmission, perhaps by sending a final "73" or a "dit-dit". If instead you call KH6XYZ as soon as you heard them sign, "de KH6XYZ TU K", you may well be transmitting at the same time and on the same frequency as WB8FSV, who KH6XYZ is trying to listen to. This is a good way to make KH6XYZ dislike you and decide not to answer you. This polite advice does not generally apply to tailending a rare DX station. Calling and working rare DX stations is usually a mean and cut throat procedure. Another reason I much prefer friendly domestic CW QSOs over fighting for rare DX.

At times you may be waiting to tailend a ham QSO, when the station you would like to talk to ends their last transmission with a "CL" for "closing" or "clear". This indicates that person is signing off and leaving the air, turning off their rig, and will accept no other calls. If you call the CLing station anyway, they may still reply out of politeness, but they are probably anxious to leave. If you just have to talk with them, don't keep them too long.

Breaking In

Breaking into an ongoing conversation is also possible, although rarely successful. Breaking into a QSO on CW is much more difficult than on phone. It is rarely done on CW. Some folks will think you impolite and ignore you, many newer hams will have no idea what's going on and consider you to be QRM. If you want to try, the standard method on CW is to wait between transmissions and then send "BK" for break, or better yet send, "BK de WB8FSV" if you have enough time. Allowing a third person to break into your contact can be confusing, especially for new hams. These "roundtable" QSOs are easier to manage on phone, or in the controlled environment of an organized net, like an NTS traffic net. But don't worry, breaking in is rarely encontered on CW. For those new hams who later move from CW to phone, be careful about using the word "break" on phone or SSB. On phone many hams use "break" to interrupt a net or a conversation when they have an emergency to report.

"Break in" has another meaning in CW. It refers to the time it takes your receiver to recover after you stop transmitting. Most modern transceivers have what is called full break in, meaning that you can receive instantly after transmitting on CW. You can even receive in between the dits and dahs of individual letters. Full break in CW even has its own Q signal, QSK. Years ago radio receivers had a several second delay before you could receive after transmitting, in order that your sensitive receiver was not overloaded by your nearby transmitter. Full break in CW is taken for granted today, but it is one of many technological innovations that today make ham radio so much easier. Such as dual VFOs, digital readout, automatic tuning, or one of my favorites: direct frequency keypad entry.

What Do You Talk About? The Art of Rag Chewing

Now that you have established contact with another ham via CW, what the heck do you talk about? Every ham contact, CW or phone, consisits of at least three basic items: your name, your location or QTH, and a signal report(RST) for the other station. What order you send these three items is unimportant, although commonly today you will hear signal report/location/name. When I started in ham radio 29 years ago, the order was almost always signal report/name/location.

The Standard name/location/RST/73 QSO

These three items are the essential minimum required for a QSO. While it is true that in working a DX station in a pileup you may only exchange callsigns and a signal report, in a "real" contact the name/location/RST are standard, and you continue from there. The next most commonly discussed subjects in CW QSOs are usually the weather(WX), the radio equipment people are using, the hams' ages and how long they have been hams. For many CW contacts that will be the extent of the contact. The other ham will sign off and end the contact. Most likely because the other ham is new to CW conversation making, and simply doesn't know what else to say. Or perhaps the short-winded ham isn't into making conversation. Personally I enjoy longer CW contacts, called "rag chews".

QSO Template for Beginners

When first starting out on CW, many new hams will often use a tem-

plate or model, to make sure they send all the essential information. For example:

"_____ de WB8FSV TNX FER CALL BT MY NAME IS JACK JACK BT QTH IS HILLIARD, OH HILLIARD, OH BT UR RST IS ___ BT HW COPY?"

And perhaps on your second transmission:

"_____ de WB8FSV TNX _____(name) FOR NICE REPORT BT MY RIG IS A KNWD TS 450 ANT IS A DIPOLE BT WX IS _____ TEMP IS ___ BT HW COPY?"

Just fill in the blanks to fit the QSO, inserting your own callsign, name, QTH, and rig. And go on from there as a starting point if you choose. By the way, that strange BT is used in CW as a spacer, a device to separate your thoughts. Some folks will use a period instead. BT is sent in CW as (dah dit dit dit dah). The CW letters B and T sent together.

I feel that a more professional CW technique is to limit the amount of punctuation used during a QSO. Some new hams may send four or five BTs in a row while they think about what they will send next. One or two BTs in a row should be enough. Here is what I mean by limiting punctuation, "TNX DAVE UR RST IS 579 579 MY NAME IS JACK JACK ES MY QTH IS HILLIARD, OH HILLIARD, OH BT HW? N1XYZ de WB8FSV K". There, I got away with using just one BT.

Other Stuff to Talk About

For some beginning hams, and for some experienced hams too, that is all the information they will willingly send to you. You may have to draw out more conversation from them. Kinda like pulling teeth. HI . When I work a new ham on CW I often end each of my transmissions with a question to give the other guy(or girl) something to talk about, to draw them into a conversation. For example, "How many states have you worked? Any DX?" or "Is it raining at your QTH also?" If the other ham mentions something such as their age and how long they have been a ham, you can take that as a hint they would like you to send them back the same information about yourself.

If you live in a small town, describe where it is in relation to a much larger city. Does the area where you live have any unusual characteristics that other hams might find interesting? I often tell other hams that I live on the edge of town - two blocks from cornfields. Or that central Ohio is a flat as a pancake due to glaciers scraping it level 15,000 years ago. Or that Hilliard is Ohio's fastest growing city. What is your town's population? Any famous or semi-famous people born there(besides yourself)? How large is your yard? Where is your radio shack located in your house?

Over the years I have developed a number of topics that I may bring into a CW contact in order to keep the conversation going. Even for me sometimes I just run into a wall, my mind goes blank, and I can't think of what to send next, so these commonly used topics of mine can come to the rescue at times. For example, I'll describe how my cat Rasta often naps on top of my TS 450 rig and I believe that after all these years I suspect my cat understands CW. Or I'll describe what I see at that moment out my basement window. Or talk about how I enjoy collecting stuff(stamps, baseball cards, radios, QSL cards). Or

ask the other ham if they have access to the Internet to see if we share a common interest about computers.

I try to send the name of the other ham I am in contact with at least once during each of my transmissions. This frequent use of the other person's name makes for a friendlier QSO and tells them you care who they are. Don't get carried away with this personalizing your comments. Using the other ham's name once per transmission is enough.

When you first start out, any CW contact is fun. It's cool to see how far your equipment will reach, how many states you are able to work. After you have made a number of CW contacts you may discover that the best contacts are those that are different. Not the standard name/location/RST/rig/WX/age/73 type of contact. You may meet another ham who just loves to gab(like me) or who is involved in a different ham activity(such as satellite or packet) and would love to tell you about it, or another ham who may have a lot in common with you such as age, work, or other hobbies. One of the fascinating things for me about making ham radio contacts is you don't know what the other ham is like or how the conversation will develop until you begin.

Standard Operating Techniques
Correctly Reporting RST

Here I am including a few useful topics that didn't fit in elsewhere. For example, what is this **RST** thing? It is a method of giving another ham a signal report and stands for readability, signal strength, and tone. R is on a scale of 1 to 5, and both S and T on a scale of 1 to 9. An RST of 599 would be the strongest cleanest report possible. For really incredibly strong signals some hams will refer to a 20 or 30 over S9, reflecting an S-meter reading. Readability is self-explanatory, R5 is normal, R4 to me means you copy more than half of what is sent, and R3 to me means you only hear a word or two. I have **never** given another ham an R of 2 or 1. Signal strength is pretty subjective, just use your ears to judge. Some new hams use their rig's S-meter to determine the S they report. I don't think this is a good idea. Tone is the most misunderstood and misused report. Only rarely will I give a report less than T9, and then never lower than T8. For example, if someone has a bad AC hum on their signal, key clicks, chirp, or is drifting badly in frequency, I may give them a T8. Giving a tone report of less than T9 may really get the other ham worried about the quality of their transmitted signal, so be prepared to explain what you mean.

The RST report that one ham gives to another often influences the RST report that is received in return. If, at the beginning of a QSO, the other ham first gives me a good 599 report, I find myself more likely to send them back a good report also. I believe we do this subconsciously, it is human nature. As an optimist, my RST reports generally tend towards the positive. Even if it is a contact during which I send the first RST, I may well add an S point or two to the other ham's RST. An S point or so above what I might give if I were brutally honest. I want to begin the QSO on the right foot and make the other ham feel good about continuing the contact.

Not uncommonly when you hear a ham send an RST report, for example 599, they will send the letter "N" in place of the number "9". Or 5NN in

this case. This number code is another time saving device used on CW. Or you may hear the letter "T" sent in place of the number zero, "MY POWER IS 2TT WATTS". Each "T" is usually sent several times in length longer than the actual letter T to distinguish it from a T. There is a number code for almost every number, even though the N and T codes are virtually the only ones you will **ever** hear. Although during the 1998 CQ WW DX Contest I heard many European CW stations report their zones as "a4" or "a5" instead of sending "14" or "15". It saved them several milliseconds of time I suppose. Here is the entire number code, for the interest of those old timers reading this. Its use probably dates back half a century in CW.

1 = a	6 = 6
2 = u	7 = b
3 = v	8 = d
4 = 4	9 = n
5 = e	0 = t

How to Zero Beat Another Station

CW stations should always try to zero beat each other. That means to adjust your rig's transmit frequency to exactly match the transmit frequency of the other ham you would like to talk to. Hearing two CW stations conduct a conversation a few hundred cycles apart is a waste of frequency space, and is inviting QRM. How does one zero beat another station? Easy to do on phone or SSB, just tune so that the other fellow's voice sounds normal. But trickier on CW because when you put your receiver exactly on a CW station's transmit frequency, you hear nothing, zero. In modern transceivers, in the CW mode, the receiver's BFO is offset from the displayed, transmit frequency in order to produce an audible tone. In other words, the transmit and receive frequencies are far enough apart for you to hear a pleasantly pitched tone when your transmitter frequency is tuned to exactly that of the ham you are listening to. This frequency offset is frequently about 600 Hz or Hertz.

Here is how I zero beat another CW station with my own rig, a Kenwood TS 450. I tune into, or sweep through, the other CW signal, the pitch going from high to low, until the other ham's CW signal disappears. Now my receiver is zero beat with the other ham's transmit frequency. But I want my transmit frequency to be zero beat with the other ham's transmit frequency. So then I tune again, with the other ham's pitch going from low to high, until I am 600 Hz away. For example, if the other ham's transmit frequency is 7137.90 kHz, I would tune my transceiver to 7137.30 (7137.90 minus .60 equals 7137.30.) to transmit exactly on his transmit frequency. The direction you tune or sweep, the pitch going either from high to low or going from low to high, is rig dependent. On Kenwood ham radios you would tune the pitch from high to low as you tune higher in frequency, to reach the 600 Hz offset and be zero beat with the others ham's transmit frequency.

This zero beat frequency stuff is pretty weird, it confuses me at times, and I hope I explained it correctly. The frequency offset for CW in most transceivers explains why when you are listening to a CW signal in the tranceiver's "CW" mode, and you switch to phone, to "LSB" or "USB," you loose the CW signal and have to go search a bit for it again.

Using CW Abbreviations and Q Signals

Abbreviations are **very** commonly used in CW. They save time and are, I think, one reason why CW is so cool. Once you have learned many of the abbreviations as well as CW operating techniques, you are "in", you're a member of the CW using fraternity. Knowing and using CW correctly is kinda like belonging to an exclusive club. Anbody can pick up a microphone and talk on the ham bands; doing CW requires skill and finesse.

Lists of abbreviations and Q signals used on CW are available many places, I will just mention a few of the most commonly used.

ADR	address
GN	good night
RIG	station equipment
AGN	again
GND	ground
RPT	repeat
BK	break
GUD	good
SK	end of transmission
BN	been
HI	the telegraphic laugh
SRI	sorry
C	yes
HR	here
SSB	single side band
CL	closing
HV	have
TMW	tomorrow
CUL	see you later
HW	how
TNX-TKS	thanks
DE	from (French)
N	no
TU	thank you
DX	distance
NR	number
UR	your
ES	and (French)
NW	now
VY	very
FB	fine business
OM	old man
WX	weather
GA	go ahead
PSE	please
XYL	wife
GB	good bye
PWR	power
YL	young lady
GE	good evening
R	received as transmitted
73	best regards
GM	good morning
RCVR	receiver
88	love and kisses

And the International "Q" signals, recognizable in any language:

QRL	Is the frequency busy?
QRT	stop sending
QRM	interference
QRX	wait, standby
QRN	noise, static
QSB	fading
QRO	increase power
QSL	acknowledge receipt
QRP	decrease power
QSY	change frequency
QRS	send slower
QTH	location

Don't get worried about using abbreviations when you are starting out with CW. It is perfectly OK to spell out every word during a QSO. It's just easier using abbreviations. There are many more CW abbreviations and Q signals, but those should keep you busy. There are also a whole series of QN_ signals for use on CW traffic nets. Also used commonly on CW are punctuation marks; the period, comma, question mark and BT being the most common. To separate thoughts or topics

during a CW contact a period or a BT (dah dit dit dit dah) are commonly used. You'll hear the slash symbol sometimes (dah dit dit dah dit) to note portable or QRP operation for example. Like WB8FSV/9 or WB8FSV/QRP.

The "K" letter used at the end of each CW transmission indicates, "end of transmission - go ahead". When two hams engaged in a CW conversation do not wish to be disturbed by anyone else breaking in, they may send "KN" instead of "K" at the end of each transmission. Or if a ham wants to limit the extent of his CQ, he may also use KN. For example, "CQ VT CQ VT de N1XYZ KN" says this ham would like to be answered only by hams in the state of Vermont.

Here are a few other commonly heard CW expressions that are actually combinations of letters sent as a single character. You will encounter these CW symbols on the air.

Wait, stand by (AS)
dit dah dit dit dit
Slash (DN)
dah dit dit dah dit
End of message (AR)
dit dah dit dah dit
End of contact (SK)
dit dit dit dah dit dah
and of course, Break (BT)
dah dit dit dit dah

At the very end of a CW contact you may hear the two stations sending dits at each other, this derives from the old expression, "shave and a haircut, two bits". It sounds like dit dit-dit dit dit, dit-dit. The first station will send the dit dit-dit dit dit and wait for the second station to send dit-dit in return. This was more popular on CW years ago, but you will still hear it today. Today it may be shortened to sending just the final dit-dit, as in "73 N1XYZ de WB8FSV GN dit-dit". New hams more frequently use the full dit dit-dit dit dit, dit dit expression than more experienced hams. Not uncommonly when I end a QSO on the novice bands and trade dit dits with the other ham, I may hear a third, or even a fourth station add their own dit dit. They were listening along in silence to our QSO, and decided to add their two bits as well. This is an unprofessional operating habit. If the eavesdropping station wants to make their presence known with a few dits, I believe they should go ahead and tailend one of us, and start a legitimate QSO. Just goes to show that as you transmit on the ham bands, there are likely more than just a few folks listening.

Obscure, Rarely Used CW Characters

To be honest, I have never heard any of these CW characters in 29 years on CW, but it is still fun to know they exist. Do not use them on the air, other hams will not have any idea what you are sending.

Colon [:] dah dah dah dit dit dit

Underline [_] dit dit dah dah dit dah

Semicolon [;] dah dit dah dit dah dit

Paragraph [ ] dit dah dit dah dit dit

Hyphen [-] dah dit dit dit dit dah

Dollar sign [$] dit dit dit dah dit dit dah

Double hyphen [=] dah dit dit dit dah

Multiplication sign [x] dah dit dit dah

Quotation ["] dit dah dit dit dah dit

Addition sign [+] dit dah dit dah dit

Apostrophe ['] dit dah dah dah dah dit

Understood [ ] dit dit dit dah dit

Left bracket [(] dah dit dah dah dit

Attention [ ] dah dit dah dit dah

Right bracket [)] dah dit dah dah dit dah

Underline [_] dit dit dah dah dit dah

To transmit a fractional number in CW, send a slash[/](dah dit dit dah dit) between the numbers in the fraction. One half is transmitted as 1/2. To send a number that includes a fraction, transmit a hyphen between the whole number and the fraction itself. 5 2/3 is sent as 5-2/3. To indicate the percentage sign, transmit the figure zero followed by the slash and the figure zero again. Similar to the fraction, a hyphen is used to transmit a whole number, or a fraction, followed by a percentage sign. For example 2 % is transmitted as 2-0/0. To send the minute sign[‘] or the second sign[“] used in latitude and longitude coordinates, use the apostrophe once or twice as appropriate. There are also 12 or more Morse Code characters for letters used in certain European languages which use the Latin alphabet. Thanks again to L. Peter Carron, JR., and his book, *Morse Code:The Essential Language*, The American Radio Relay League, 1991, for these obscure CW characters.

Here are a few of the auxiliary CW characters used with some European languages, thanks to Chuck, KB2E, in his letter to the FISTS Keynote newsletter. "...the German A with two dots over it, Ä, (dit dah dit dah); the Spanish-Scandinavian A with an accent mark, or a dot, over it, Å, (dit dah dah dit dah); the German-Spanish CH (dah dah dah dah); the French E with an accent over it, É, (dit dit dah dit dit); the Spanish N with that wavy line over it that we all know now because of the infamous El Nino, ñ, (dah dah dit dah dah); the German O with two dots over it, Ö, (dah dah dah dit); and the German U with two dots over it, Ü, (dit dit dah dah)." I am uncertain of the precise linguistic terms attached to each of these diacritical marks, whether they be grave, umlaut, or circumflex, but you get the idea. I have never heard them used in CW, but then again I don't work very many Europeans on 40 and 80 meters.

Taking Notes During a QSO, Logging, Using GMT/UTC Time

While I am in contact with another station CW station, I take notes. In fact I write down every word sent by the other ham. Mainly this is because I have a memory like a screendoor in a submarine! But I recommend at least noting the main points made by the other station, so that you will remember what to comment on during your next transmission. I circle with my pen those items I want to remember to bring up next go around.

I am kind of strange in that I save all these notes I've taken during my QSOs, going back 29 years. Really. It is absolutely fascinating to go back through my notes and read, word for word, what I talked about when I was a novice 28 years ago. Kinda like a ham diary. By FCC regulations we are no longer required to keep a log of the radio contacts we make, but I **highly** recommend it. Not only for QSLing purposes, but

so that you can look up when in the past you worked a familiar callsign. And looking through your old logbooks will bring back lots of pleasant memories of QSOs gone by. I keep copious notes in my logbook, beyond the standard date, time, frequency, callsign, RST, name, location, to help me remember what was special about each contact.

I fill out as much information as I can in my logbook at the very beginning of each QSO. This saves me time and, if I accidently bump the VFO dial during the QSO and change frequency, I can use my logbook to look up my original frequency. Or you can use your frequency lock control if your rig is so equipped. My cat Rasta has been known to jump up on my desk while I am QSOing and rub against my VFO before I can stop him. Perhaps my cat did not like the other ham's fist. HI.

After you have been on the air a while, another ham will someday surprise you during a QSO by using your name before you give to them, or asking if your old Heath DX 60B transmitter is still running. How did they know your name or about your rig? Turns out you have worked this ham before but forgotten, and they either have a very good memory, or they keep their log on a computer. I would love to put all 29 years of my ham contacts in a computer database, but whew! The data entry would take months. If you are just beginning your ham career and have a computer, then get some logging software.

Hams should always use GMT or UTC time when logging and keeping records. Try to keep a schedule set up for 8 pm with another ham who lives in a different time zone. Do you meet at 8 pm your local time or 8 pm their time? No problem if you both use UTC time. Always fill out QSL cards using UTC time. Do not use 24 hour military time. Confusion often arises when you make a ham contact close to 0000 hours UTC. Because in UTC the date changes at 0000 or midnight UTC. What date do you put on your QSL card? Use the UTC date. I frequently receive QSL cards from new hams with the correct UTC time but the wrong date. They have grown up accustomed to the date changing at midnight their own local time.

Keeping track of the current time in UTC takes practice. You could tune your receiver to a time standard station like WWV or CHU to determine the current UTC. Clocks are available that tell time in UTC format. Or you could, like me, just memorize your local/UTC equivalents. You can make a little chart with your local/UTC equivalents. You will need to make two such charts since local/UTC equivalents change twice a year, with the switch between daylight time and daylight savings time. This twice yearly switch pretty much takes place all over the world, not just in the United States.

Identifying as per FCC Regulations

Speaking of FCC regulations, amateur radio operators are required to identify themselves on the air by transmitting their callsigns. At least every ten minutes. I believe it is also a good idea to identify at the beginning and end of each of your transmissions as well, even if less than ten minutes has passed. You will hear some experienced CW operators taking turns transmitting during a QSO without IDing. For example:

- first station "WHATS UR WX LIKE? BK"

- second station "SUNNY ES COOL. HW ABT U? BK"
- first station "MONSOON HR. RAIN ES 70 DEGS..."

No problem as long as they ID every ten minutes. If band conditions are poor or there is lots of QRM, IDing at the beginning and end of each transmission is wise, or the other station may not realize you turned it over to them. Easy way to completely loose one another. To save time I will sometimes end my transmissions with only my own callsign, like "HW COPY? de WB8FSV K". Cool, as long as every ten minutes I start or end one of my transmissions with something like, "WHAT SAY FRED? N1XYZ de WB8FSV K"

Dealing With QRM and QRN

Characteristically, when listening to shortwave radio frequencies, which include the most popular ham radio bands, you will hear noise, static, interference, and fading. They sometimes make reception of ham radio signals difficult, sometimes downright impossible. I view them as a challenge. I call them the three dreaded Qs: QRM(interference), QRN(noise and static), and QSB(fading). With experience and practice you can learn to deal with the three dreaded Qs and enhance your enjoyment of amateur radio.

First let me discuss QRM, probably the most frequently encountered and most disturbing of the three Qs. And the only one you yourself can help reduce by your own radio operating habits. QRM is a fact of life on the ham bands, get used to it. Try to plan your operating methods so that you cause as little QRM to other hams as possible, and everybody will be happier. There are technical means to help alleviate QRM: passband filters, audio filters, DSP and RIT. For example your RIT(receiver incremental tuning) can be used to "tune out" QRM. You can move your RIT away from the interfering signal until it is nearly out of your receiver's passband tuning range, leaving just the signal you want to hear. I have found that even when there is no QRM, moving my RIT a little bit changes the tone of the signal I want, often improving reception.

With practice you will be able to eventually, with your ears alone, "tune out" many of the interfering stations and concentrate on the signal you want. Most QRM from other hams is unintentional. If you find someone intentionally QRMing you, playing games with you, the best advice is to ignore them. Do not acknowledge their presence in any way or you may encourage them to continue. Ask for a repeat, change frequency, sign off if you have to. I would not mention anything about "QRM" or "SOME LID".

Sometimes when I answer a CQing station and that station is unable to copy me, perhaps due to QRM near our frequency, I will then call them a second time after changing my transmit frequency a few hundred Hertz. That small change may allow the other ham to now hear me through the QRM. The same thing is true if some QRM suddenly appears during your QSO. Although don't QSY too far, or the station you are talking with may lose you.

You and the other station may both agree to QSY(change frequency) to escape some QRM. Be careful. Successful QSYing on CW is quite difficult. For me it works about fifty percent of the time. Quite often you will lose each other. QSY during a CW QSO with cau-

tion. Be careful to state exactly where you would like to QSY, say up 2 kHz, or to 3715 kHz, rather than simply stating, "let's QSY up" somewhere.

Another practical use to having dual VFOs in your ham rig is that you may be able to use them to chase off QRM. Sometimes during a QSO I will put both of my transceiver's VFOs on my same operating frequency. Then tune the inactive VFO a few hundred cycles(or Hertz) up or down in frequency. Whether you tune up or tune down a few hundred cycles depends on the direction that your rig's receiver "sweeps" as you tune. My Kenwood sweeps or changes pitch from high to low as I tune higher in frequency. During my QSO if I hear another ham call "QRL?" to see if the frequency is clear, I will interrupt my own QSO for a few seconds, switch to my second inactive VFO, and transmit a quick "C", meaning, "yes this frequency is in use." I could have remained on my original frequency and sent my "C" in answer to his "QRL?" But it is likely the QRLing ham would not have heard my answer due to the narrow passband of his receiver(in other words he is too far away from my transmit frequency) or due to the direction of the sweep of his own receiver. By leaving my second inactive VFO a bit off of my own transmit frequency, I can protect a larger area of frequency space around myself from potential QRM. Again, please do not answer a CQ if the CQer is too close(within a kHz or less) to an ongoing QSO in order to avoid QRMing the other QSO.

One very annoying, for US hams, form of QRM is the shortwave broadcast stations found most evenings throughout the 40 meter novice band. We have to share the band with them, I like to view it as a challenge. There will be times during a QSO when one of these broadcasting stations will sign/on and begin transmitting on or very close to the frequency you are talking on. First you will hear their unmodulated carrier as they tune up, followed by their interval signal. Then usually at the top or bottom of the hour, the broadcast station will begin their official broadcast with their national anthem. Then the news. Quite often you will lose all trace of the other ham you were in QSO with as soon as the broadcaster opens up with their carrier. Sometimes you can still hear each other through the unmodulated carrier, but you had better quickly say your 73s before the music starts. A few times I have been able to continue a contact as long as the broadcast station does not transmit music. If the broadcast QRM on 40 meters is just too much for you, there is always 80 meters. Or switch your ham receiver to the AM mode and delve into the fascinating world of shortwave broadcasting.

QRN refers to noise heard on shortwave radio. There are basically two types of QRN, natural and man-made. Natural QRN is the static generated, for the most part, by thunderstorms. The radio static, or QRN, generated by thunderstorms travels great distances via skip, just like radio signals on shortwave. At any given moment you may be able to hear the static from dozens of storms, hundreds and thousands of miles away. At a given distance from a radio station on shortwave there is a dead zone, which the radio signal skips over. Same thing is true for thunderstorm static. I have been on 40 meters CW while I knew there

was a thunderstorm nearby, and heard no static. I was in the thunderstorm's dead zone, its static was skipping over me. Other hams I then contacted were barely able to copy me through the static, although I heard them fine. Pretty weird. There are many more thunderstorms during the warm summer months, meaning that winter provides the best reception on the 40 and 80 meter ham bands. Both thunderstorms and static decrease in number and intensity with nightfall. Rarely, during a particularly intense solar disturnbance, the shortwave radio frequencies will go dead. All you may hear is a continuous rushing noise or QRN caused by the solar disturbance.

Man-made QRN comes from many sources, including automobile engines, electric motors, fluorescent lights, electric fences, loose wires on electric power lines, and lawnmowers. Other QRN is purposely broadcast on shortwave radio frequencies, such as over-the-horizon radar and high speed RTTY. It becomes what we call QRN when it is broadcast by nonhams on ham frequencies. A good noise blanker or a ham radio equipped with DSP may help reduce this noise. Before I purchased my current home, I walked the property with a portable SW radio receiver tuned to 80 meters, to determine if there was any man-made QRN inherent to the site. I heard no local QRN, so I bought the house.

HAARP QRN?

I have been hearing an interesting form of QRN on the 40 and 80 meter bands for the past several months (Oct, Nov, Dec 98, and Jan 99). A very regular and periodic QRN that builds up gradually, holds at a peak for about 30 seconds, then abruptly disappears. Followed by no QRN for about a minute and then again the gradual buildup, etc. This cycle repeats for hours at a time. It is not heard every single evening, but more often than not. In my CW converstaions I have discovered that this periodic QRN is being heard all over the East Coast and Midwest of the US, although not as well on the US West Coast. Have you heard this mysterious noise? My guess is that perhaps the source of this QRN is that gigantic government HAARP transmitter up in Alaska. The government is beaming megawatts of radio energy straight up into the atmosphere to research the ionosphere. I wish they would stop.

Oh yes, and then there is QSB, or fading. This is a natural phenomenon, one of the mysteries of radio propagation. How QSB works is not difficult to understand. Why it occurs is the mystery. There seems to be at least a little fading present on most shortwave frequencies, particularly at night. The duration and depth of the fades can vary widely. Just another challenge to make your ham radio operating and shortwave radio listening more interesting.

Repeating Info Due to QRM

It is important to ensure that the ham you are in contact with is able to copy at least the three essential items of the QSO: your name/location/RST. So normally in any CW contact these items are repeated twice, "UR RST IS 579 579 BT MY NAME IS JACK JACK" etc. If the band conditions are stinko, three repeats might be in order, of at least the name and RST. For the rest of the contact, in bad QRM, QRN, or QSB, hams have been known to employ one of two other repeating techniques. One would be, "MY MY WX

WX IS IS CLOUDY CLOUDY" and the other technique is, MY WX IS CLOUDY MY WX IS CLOUDY". I normally use the latter.

You can tell that the other ham you are in contact with is experiencing QRM if they tell you, if they ask for lots of repeats, if they get your name or callsign wrong, or if they hesistate long seconds before returning to you after you complete a transmission. If the ham you are talking with sends many more repeats than normal, you can assume they are hearing QRM on your signal, and they probably would like you to use many repeats as well. If I believe my signal is being stepped on, I will send the other ham's name more frequently than I normally would, to assure them that at least I can copy them. For example, "TNX DAVE BT MY WX IS LOUSY BT DAVE HW IS UR WX? HW COPY DAVE? N1XYZ de WB8FSV K". Even in very heavy QRM folks are more likely to pick out their own name or callsign out of the muck. Occasionally you will work another ham on CW who refuses to copy your callsign correctly. Usually you can correct them by repeating your callsign frequently at the beginning and end of your transmission. Or if that doesn't work, try, "MY CALL IS WB8FSV WB8FSV NOT WD8FSU". Amazingly a few hams on CW will continue to use your incorrect callsign regardless of what you tell them.

Correcting Mistakes in CW

Everyone occasionally makes a mistake while sending their Morse Code. Sometimes your key or keyer seems to have a mind of its own. The most common method to correct a mistake is for the sending station to send a rapid series of dits, like the number five with a few extra dits added. Eight dits is the recommended number of dits, although no one is counting. And to then send the correct CW character or word. This is fine. Personally when I send a mistake **in the middle of a word**, I don't see the need to emphasize it with the rapid dits. I simply pause and then send the correction. The station you are talking with is copying along with you, letter by letter, and they probably realize as soon as you that you have made a mistake. I feel it is more professional to use a pause rather than the rapid fire dits.

But, if I make a mistake at the beginning of a word, the other ham copying along with me has no idea I have made a mistake. So in this case a device is needed to signal that a mistake has been made. I prefer to use a question mark rather than the rapid fire dits. Another CW device you may hear less often to indicate a mistake is "dit-dit", like the CW letter I, sent once or twice after the mistake and before the correction.

You will hear some hams use a question mark to signify that they are going to repeat a word, even if they have not made a mistake. For example, "MY NAME IS JACK? JACK". This use of a question mark is frequently employed to indicate the repetition of a difficult or unusual word in a CW radiotelegram by CW traffic handlers.

How Long Should the Contact Last?

Talk as long or as short as you like. Most CW contacts on the novice bands seem to last about half an hour or so, which mean that they rarely get beyond the standard name/location/RST/rig/WX/73 stage. That is perfectly OK. I myself like to talk a bit longer. For me,

a good CW rag chew generally lasts around an hour, sending and receiving at about 13 wpm. My longest CW contact ever was a 3 1/2 hour marathon, but after the second hour we began trying to stretch it out to see how long we could go! At about 10 wpm(words per minute), a common speed on the novice bands, it can easily take half an hour just to send the name/location/RST/rig/WX/age/73 info. Normal human verbal conversation is around 120 wpm, so a SSB or phone QSO of half an hour would cover a lot more ground than a CW QSO of half an hour at 10 wpm.

How Fast/Slow Should You Send CW?

Normally, adjust your code speed to match that of the other ham you are talking to. This is especially true if you answer another ham's CQ or tailend a conversation. People commonly send a CQ at the speed they would like to be answered. If you answer a person CQing at say, 15 wpm, and you send at 10 wpm, the CQer generally will be polite and slow down to your speed. This does not always happen, so be careful about answering a CQ sent by a CW speed demon. Normally a "PLEASE QRS" (please send slower) sent to the other station will elicit the correct response from them, and they will slow down.

It is easy, especially with an electronic keyer, to send faster than you are able to comfortably receive. Try to match your send speed to that of your receive speed. With practice your speed will improve. Making CW contacts is a great and fun way to increase you code speed. Another tip is to occasionally stretch yourself, try to copy CW at a slightly higher speed than you are comfortable. Do not do this during a QSO you are having when you are under pressure to copy everything correctly. But just listening around the band. Participating in slow speed CW traffic nets is another neat way to help you increase your code speed, and perform a public service at the same time.

You'll discover a wide variety of CW speeds on the novice bands. Most folks go slow, less than 15 wpm, but you will hear hams going over 30 wpm also. They may go fast to show off, or perhaps there are no more clear frequencies available in the general bands. Some speedy novices and techs may be experienced CW operators, perhaps they were hams years ago and were recently relicensed, or learned CW in the military or merchant marine and just now got into ham radio. Also the 80 meter novice band was moved a few years ago and now includes frequencies used by higher speed CW traffic nets. You will frequently hear them in the early evening between 3675 and 3700 kHz. Many of the hams you encounter on the novice bands will be novices and technicianpluses, but there are a number of general, advanced and extra class hams to be found also. They may feel more comfortable doing CW at slower speeds or they may, like me, simply enjoy working new hams. I have been lucky in my 29 years as a ham to have been the very first contact for over 80 hams now.

How Do You Gracefully End a QSO?

It's no big deal, many hams will just send, "TNX FOR QSO 73" or "GOTTA GO TNX 73" and sign off. That is fine. Myself, I like to leave a bit more politely, such as, "DINNER HR 73", "I GOT A PHONE CALL, CUL", "TIME HR TO QSY TO BED", "MY

XYL IS YELLING, TURN OFF THAT RADIO AND DO SOMETHING USEFUL", or "SRI ED MCMAHN IS AT MY DOOR WITH 10 MILLION DOLLARS 73".

There will be times when, after several exchanges, you realize that you just don't want to talk to this person anymore. You could, as I have heard some hams do, just disappear. But I think having a few tactful excuses for leaving to choose from is a good idea.

It is not uncommon that QRM will grow to the point that it is impossible to copy the other station you are in QSO with. Some hams in this case will just give up and stop transmitting. I would recommend instead that you at least send a 73 and sign off properly. Don't leave the other ham wondering what happened to you. On your end you may not hear anything except QRM, but perhaps the other ham you were talking with still copies you fine. Maybe the QRM is one way, skipping over his location. If the QRM or QRN or QSB just destroys a QSO I am involved in, I will send something like, "SRI DAVE NO COPY NO COPY QRM QRM 73 73 N1XYZ de WB8FSV."

Occasionally during a QSO, the station I am talking to simply disappears. Maybe they have rig problems, an important phone call, or the irresistable call of nature. Try not to simply disappear. If another ham vanishes during a contact with me, first I will send a friendly, "DAVE?", and if no answer, then send, "N1XYZ de WB8FSV K" once or twice before I give up. Even then I leave my VFO on the same frequency a few minutes while I fill out my logbook and the QSL card, in case the ham reappears.

A Typical Evening for Me on 40 meters CW

Choosing My Band

After turning on my rig, getting comfortable in my chair, opening my logbook, and pulling out my scratchpad, I choose my band. I personally enjoy 80 and 40 meter CW, particularily 40 meters, so I will search between 7100 and 7150 kHz. 80 and 40 meters are noted as good rag chewing bands, as are 160 and 30 meters. Starting at 7100 I slowly turn the dial of my transceiver, stopping at each CW signal I hear. I will listen a few seconds, long enough to determine if the station is sending a CQ, or is already engaged in a conversation. I am looking for a CQ to answer, the way in which I usually begin a CW contact. Since I am not a novice or technician, I almost feel like an intruder in the novice bands, and would much rather answer than send a CQ here. Although if I am unable to locate an interesting CQ after searching for 15 or 20 minutes, I may go ahead and call my own CQ. Or perhaps search the general CW frequencies, or switch bands, or go watch TV. HI.

Scanning for CQs

A full scan from 7100 to 7150 kHz for CQs might take only a couple minutes, particularily at night when the 40 meter band will be filled with powerful SW broadcast stations, rendering big chunks of the novice band unusable. Activity on 40 meters at night is usually limited to a few small relatively clear areas in between the broadcast stations. For example, now the regions around 7108 and 7137 kHz are often clear most evenings. Several years ago 7125 kHz was always available at night, not now- this is because the SW broadcast stations periodically change their

operating frequencies and schedules. A scan of the 40 meter novice band in the daytime may take longer with the absence of the broadcast stations and with more hams. Weekends on 40 meters can get quite busy.

In most of the world the 40 meter ham band stretches from 7000 to 7100 kHz, and 7100 to about 7500 kHz is used as a shortwave broadcast band. Only hams in North and South America are able to use the full 7000 to 7300 kHz. And only in the United States is 40 meters divided into different phone and CW segements. Hams in Canada and in South America can use CW or phone anywhere within 7000 to 7300 kHz. This explains why you can hear Spanish speaking SSB phone stations some evenings in the 40 meter novice band. This is a good indication of band conditions, how 40 is often open deep into South America in the evenings. When the band conditions are good, you may even hear European or Asian SSB stations just below 7100 kHz.

Once I discover a CQing station, I first determine if that ham will be able to hear or copy me. If the CQer is relatively weak, chances are they will be unable to copy me. Generally the stronger the station you hear, the greater the chance they will hear you in return. Radio propagation is usually two way. Not always. Sometimes it is fun to call a weak station just to see if your rig can reach them. Perhaps the other ham's signal is weak because they have a less than optimal antenna system, such as a dipole in their attic. Or maybe they are using QRP(low power). After scanning the band for a while and perhaps making a few calls, you will be able to judge the condition of the band. Is the skip long or short? Is the band open to the West Coast, south to Florida, or not at all. Occasionally I will turn on my rig , listen a bit, try to answer a few CQs to no avail, make a few fruitless CQs myself, then give up and go play on the Internet. Particularily true during the last few years with the bottom of the sunspot cycle upon us. The next sunspot cycle, Cycle 23, is just now beginning and radio propagation conditions are slowly improving.

Do I Want to Answer this CQ?

But, let's say I hear a strong CQ. Next I determine if I want to answer this CQ. Since I enjoy working new hams, a ham with a new callsign gets first priority by me. After you are on the air a while, you can pretty well guess how long a ham has been licensed by just their callsign. Usually, I am attracted by certain types of callsigns. For example a one by two call, like W8TZ, is usually an old timer. They often enjoy rag chewing and are full of fascinating ham stories and experiences. Callsigns that form words intrigue me, such as KA4TON or N3HAM, or callsigns that are similar to mine, like KB9FSW. In 27 years on the ham bands I have worked only five other FSV callsigns: W3FSV, KA1FSV, VE3FSV, WB4FSV, and WA0FSV. I treasure those QSL cards. My wife and I love New England and my ears always perk up when I hear a 1 district callsign. From Ohio I seem to have a pipeline into New England, meaning I find it quite easy to work New England hams.

Often when I hear a CQ, I will quickly look it up in the Callbook, to discover what city the ham is calling from. Perhaps it is a city or state I have visited or vacationed in, have friends or family in, have a favorite sports team in, in other words have some connec-

tion to that we can talk about in our potential QSO. My computer is upstairs and my radio room is downstairs, so I cannot access a CD callsign database. Therefore I use a printed Callbook. Even a Callbook a couple years old helps I believe. It enhances my ham radio operation by allowing me to discover a little more information about a ham before I decide to answer their CQ. Unfortunately 1997 is the last year that printed Callbooks will be available. Too bad, it is the end of an era. Of course after I have completed the contact, and am filling out the QSL(I try to QSL **every** contact), I use a callsign server on the Internet to get the ham's current mailing address.

Not having a printed Callbook or access to a callsign server is perfectly OK. It just means you will wait a few moments longer to discover to whom you are talking. The suspense can be exciting. You can still QSL the other ham by asking them to send you their mailing address over the air, or to send you their card first.

Making a Contact

So now I've decided to answer the CQer and establish a contact. A one by two call should be sufficient on my part. Although if band conditions are lousy, something like a one by three or a two by four might be more appropriate. I have already made sure my rig is tuned up and ready to transmit. Your ham transmitter must be tuned so that there is an impedence match between the transmitter and the antenna, ensuring the best possible transmitted signal. Many modern transceivers include an automatic antenna tuner which makes tuning a breeze. When tuning up your rig do it as quickly as possible so you don't cause unecessary QRM to others. Even if you use an automatic antenna tuner you are transmitting a weak but audible CW signal over the air. Tuning up without an automatic antenna tuner usually means you are transmitting a very strong carrier over the air. Make it short please. Actually you should be using a dummy load to tune into, so that you are not heard over the air. If you must tune up on the air, try to do so on a clear frequency, or perhaps on top of one of those 40 meter shortwave broadcasting stations.

And the CQing station comes back to me. Hooray! It's a KF4 station in North Carolina, a ham I worked about a month ago. The callsigns in this story have been changed to protect the innocent. HI. He doesn't remember me, but his callsign and QTH seem familiar, so I look in my logbook and find him. On the average I make about 20 CW contacts a week, mostly on 40 and 80 meter CW, so I commonly hear and work the same stations more than once. After we exchange the standard name/location/RST, I ask him if he has received my QSL card yet and how many states he has worked so far. He remembers our previous contact. During our first QSO the KF4 had only been on the air for a couple weeks, and at about 10 wpm and with lots of mistakes, the minimal name/location/RST was enough to deal with. Now on our second contact we are able to find out more about each other. Hey neat, he is into computers also. We swap e-mail addresses and I tell him about my homepage. I will e-mail him tomorrow and send him the address of my homepage. Sending http addresses on CW is not easy. I am forever having to explain what a tilde is. My KF4 friend in North Carolina says thanks for the FB QSO but it is almost

his bedtime. I send him some of my famous personalized QSO ending lines, and we both sign.

Some hams on CW soon develop several of their own personal phrases or expressions to liven up and personalize their QSOs. There are the standard CW phrases that everyone uses such as, "HOPE TO CUAGN, NICE TO MEET U, BEST 73 TO U ES URS". These are perfectly OK, but I like to use some of my own unique CW expressions, "RAIN HR, GREAT STAY INSIDE ES HAM WX or ENJOYED QSOING WID U or HELP QRM ATTACK!". To hear my best ones you will have to work me on the air. QCWA magazine(Quarter Century Wireless Association) regularly prints many of the humorous CW expressions that its members have heard on the air.

It is almost my bedtime also, but I would like to squeeze in one more CW contact. So after logging my KF4 contact I begin another band scan for CQs. 40 meters tonight is pretty noisy and filled with three very loud SW broadcast stations, normal. I've been looking now for fifteen minutes after my contact with the KF4 station, and found no CQs. Each time I have scanned across the novice band I noticed the area around 7145 kHz is clear. Perhaps I will call CQ here myself if I can't find any other CQs. But then I do hear a weak CQ from a new ham, a KC2. He is pretty weak, meaning I may well be weak to him as well, but I answer his CQ anyway. There isn't much else going on. Low and behold, he comes back to me.

He does not have a very good fist, his CW spacing is way off, he makes a lot of mistakes, and his CW operating technique needs work. But I am still able to copy about 75 percent of what he sends, and make a good guess at the rest. I copy, "THIS S TY FERST QSO". I am his first contact. Infinitely cool. My favorite kind of contact. I live to make first contacts. My new KC2 friend only sends his QTH once, half of which I loose in the QRM, and he forgets to send his name and my RST. Still I believe it was a fairly successful first QSO. The contact took about 45 minutes, mainly since we were working at less than 5 wpm and I sent many repeats of my information.

I have a great deal of patience with new hams. After all we were all new hams at one time. Most hams well remember their first contact. My own first contact was at 5:30 pm on Feb 6, 1970 on 15 meter CW with a WB8 station. It was a local ham across town. I had to telephone her to ask her to listen for me on the air. I had been calling CQ for two days with no answers. Later I discovered that a vertical antenna mounted on the roof needs to be grounded. This was news to me. After I put some radials on my vertical I began to get lots of answers to my CQs.

It is getting late and the KC2 and I both sign off. I fill out my logbook and a QSL card for the KC2, including a short letter congradulating him on his first contact. Time now to QSY to bed. I turn off my Kenwood TS 450, and **disconnect the antenna.** The end of a most successful ham radio day. In two evening hours I have renewed acquaintances with an old ham friend and made a new ham friend. What a neat hobby!

Straight Key, Electronic Key, Bug, or Computer Keyboard?

There are basically four types of devices used by most hams to send Morse Code. The straight key, also

called the hand key, as well as the electronic keyer, the bug, and the computer keyboard. My favorite is the straight key, which I use 90 percent of the time. The straight key is more natural, more organic, and so is the resulting code. Learning to use a straight key well is not easy, it takes a great deal of practice. Pounding brass well with a straight key is an art. I am far more impressed when I hear an excellent "fist" on a straight key than I am with near perfect code sent with an electronic keyer.

I own two electronic keyers which I use mainly when I want to send faster speed CW. 15 wpm is about the top speed you can send intelligible code with a straight key. Although I have heard hams send good CW at 20 to 25 wpm with a straight key- it amazes me they can send that fast. Learning to use an electronic keyer, while it takes practice too, is easier than learning to use a straight key well. Once you have mastered the electronic keyer, using it can be a real pleasure. To effortlessly and gently squeeze those two paddles and produce near perfect code is one of the great joys of CW. I still prefer the organic/natural sound of a straight key fist to the mechanical sound of an electronic keyer. Hams using a straight key have a fist with personality. On an electronic keyer your fist sounds like everyone else's. Usually. Some new hams have difficulty sending with a keyer. I believe learning to send CW first on a straight key before switching to an electronic keyer is a wise method.

Speaking of personality, that to me is the biggest advantage to using a bug. Although a bug also produces code mechanically, the operator has complete control of the length of their dahs. This gives the ham the ability to send with their own distinctive fist, or "swing". Unfortunately, learning to send well with a bug takes years of practice, and a bug is notoriously difficult to adjust. Using a bug well is a challenge, almost like playing a musical instrument. After practicing on my own bug for five years, I developed a passable fist, until last year when my cat knocked my bug off my desk onto the floor. It hasn't sounded right since then. I hope my cat Rasta is not a no-code cat. After listening to CW stations for a few years, identifying the distinctive "swing" of a bug user is easy. When you hear someone sending good code with a bug, you are listening to a CW Master, a highly trained expert who has honed their CW skills through years of patient determined experience. In the hands of such a CW Master, a bug is capable of producing beautiful enchanting Morse Code.

A quick word about sending CW with a computer keyboard. Some Morse Code challenged hams use this method to generate and send CW. But for the most part I don't like computer generated and decoded CW. For me, using a keyboard is not "real" CW. Even worse is to use a Morse Code reader that decodes and prints out the code for you. A traditional amateur radio operator sends and receives CW using their own senses and faculties. I find computer generated and decoded CW too mechanical and impersonal. But at least it is CW.

FISTS - A Cool Club for CW Operators

There is an international organization dedicated to promotion of the use of CW in the ham bands. This group or club of hams is called **FISTS**, and is

also known as the International Morse Preservation Society. I have had great fun since I recently joined FISTS. At times it is difficult to find another ham to talk with on CW. The FISTS club promotes several ham radio frequencies. those for example ending in 58: 14058, 7058, or 3558 kHz, as places to find other FISTS members to rag chew with. Another aim of FISTS is to encourage friendship within the club membership. which they do in part with these CW calling frequencies. I love to rag chew on CW and it is great knowing where to find others with the same interests. They also offer several awards for working 100 members and for working at least one member in each of the 50 United States. There are over 6000 FISTS members now, but finding one in each of the 50 US states is quite an undertaking. Only 4 hams have achieved this award so far.

Not long ago I worked my 100th FISTS member and qualified for my Century Award. Cool. Took me seven months. As much fun as working new FISTS members and adding to your total, is running into folks you have already worked and deepening friendships. After a couple QSOs you learn each others' names without having to look them up in your log. Of course you do not need to be a FISTS member to do this, but FISTS folks seem to me to be friendlier and more likely to rag chew.

Neat FISTS Story -

I was lucky to have been able to attend the 1998 Dayton Hamvention, May 15-17. Actually since I only live 72 miles from Hara Arena in Dayton where the Hamvention is held, I have attended every year for nearly 24 years now. I know how fortunate I am. This year I made it a point to attend the FISTS party Friday evening, hoping to put faces to some familiar calls. There I met Geo, G3ZQS, the founder of the FISTS organization, FISTS number 01. He came all the way from England to the Dayton Hamvention and to meet FISTS members. Neato. I drove home later that evening, and, still full of radio enthusiasm, I got on the 7058 FISTS frequency about 10 pm. After one FISTS QSO I heard a weak CQ FISTS and discovered it was Geo, operating as W8/G3ZQS. Using a friend's rig Geo was operating from his hotel room with a whip antenna on a truck bumper. It was quite a thrill to finally work Geo on the air, particularly since I had just had an eyeball QSO with him. A mini FISTS pileup on Geo thereby ensued.

How to Get Zillions of QSLs

My second favorite ham activity, after rag chewing, is collecting QSL cards. Guess it's because I love to collect stuff. I average one or two QSLs in my mailbox every day. One important secret to successful QSLing, at least among US hams(not DX), is to send your QSL card out first. If you wait for the other folks you work to send you their cards first, you can expect to receive at best one QSL for every ten contacts you make. One out of 20 is more likely. I try to QSL every single contact I make. I realize that can get expensive postagewise, but to me it is worth it.

Another important secret to QSLing is, I believe, to personalize your QSL card. Be sure to put a note from you on the QSL, with as much personal information as space permits, about what you discussed in your contact. My own QSL card contains all the required information just on the front of

the card, leaving the back free for me to fill up with my personal notes to the other ham. My own QSL cards are homemade. I drew the picture on the front, and I print them on the copier at my workplace(don't tell my boss). This further personalizes my cards. I always mail my QSL inside of an envelope, thus ensuring my card arrives relatively unfolded, smudged or otherwise mutilated. I think folks appreciate a QSL in undamaged condition, and I seem to get more returns that way. Again the postage costs more for an envelope, but that is the reason I go to work every day. To make money to pay the electric bill so that I can ham, and so that I can pay all that postage. HI.

Finally, if there is a ham station from which you really need or want a QSL card, such as in Vermont or Hawaii, I would include a first class postage stamp with the QSL inside the envelope. Thus the other ham has one less reason not to return his or her QSL to you. An SASE(self-addressed stamped envelope) sent to the other ham is also a good idea, saving them the trouble of writing out your address. I myself do not usually send an SASE, because hams occasionally have oversized QSL cards that may not fit inside the SASE envelope you send them. Hams who live in rare states like Wyoming I'm sure are overwhelmed by QSL requests, and sending them return postage or an SASE increases your chances for their card. A connection to the Internet and a callsign server is an asset. An up to date address to which to send your QSL is a must.

Some hams who live in a small town regularly give the name of their QTH as that of a nearby larger city so that other hams will know where they are located. Not a good idea. Be proud of your own small town. If the QTH you give over the air does not match your mailing address(the address in the Callbook or callsign server), you may confuse hams when they later try to mail you their QSL card. They may decide not to send you their card.

Keeping accurate records of to whom you have sent, and from whom you have received QSL cards is important. Your logbook is a convenient place to do this. Sometimes I receive two QSLs from a ham for the same contact. They first mailed their card to me. But when they later received my QSL they could not remember, or had poor records, of whether they had sent me their card. So they mailed me a second card to be sure. I suggest filling out the QSL card that you intend to mail very soon after you make the contact. The QSO will still be fresh in your mind so that you are better able to write personal comments on the card, and so that you are more inclined to fill out and mail the QSL. Don't wait until you have a large stack of cards to send. QSLing then becomes more of a chore than a pleasure, and less likely to get done.

When you first begin to receive QSL cards, it is fun to display them up on your wall, in those clear plastic containers commonly available. After you have received a large number of QSLs, it becomes necessary to store them in a convenient place. Convenient because you well may wish to look up an old QSL card months later if you work the station again. Finding an old friend's QSL while you are QSOing them can enhance the contact. I keep my QSL cards in shoeboxes. I have filled six shoeboxes now. For quick easy access I keep the cards organized by US call dis-

tricts 1, 2, 3, etc., and then by callsign type, KA1s, KB1s, N1s, WA1s, WB1s, K1s, W1s, etc. This is the next best method for keeping your cards organized and findable, short of keeping a computer log.

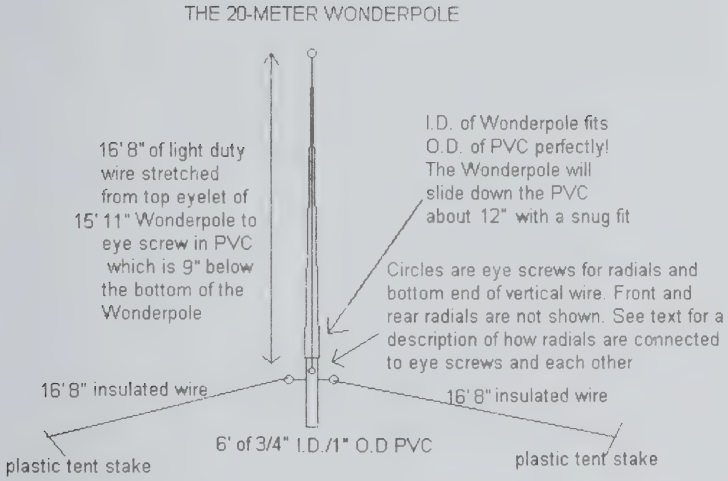
I feel my QSLing methods are fairly successful. I get about a 75 percent return rate on the QSL cards that I send out. New hams generally QSL better than more experienced hams. CW operators generally QSL better than phone operators. Jack Wagoner WB8FSV

The 20-Meter Wonderpole

by Joel Kluender, NF9K
870 Prairie St. S.
Shakopee, MN 55379

In preparation for a backpacking trip to Montana which I'm planning for next summer, I wanted to come up with a 20-meter antenna for use in the field. I had four main objectives: (1) It had to be cheap, because I can hardly afford the trip in the first place. (2) It had to be lightweight (to be carried while backpacking at 9000 feet+ elevation!); (3) It could not rely on any trees or other natural structures for support; (4) It should be easy and quick to erect (< 15 minutes) What I came up with is a way to construct our old friend the quarter-wave ground-plane vertical in a way which meets all of the above objectives. Below are instructions on how to construct it.

Go to your local hunting/fishing store and buy a Shakespeare 16' Wonderpole crappie rod. This is a hollow telescoping fiberglass rod which weighs a hair under 1 lb. and extends to nearly 16 feet long (mine measures at 15'11"), and collapses to 3' 10". This is the most expensive part of the antenna - mine cost $15.99. Buy 4' and 2' sections of ¾" I.D./1" OD rigid PVC which can be joined at one end (if you are not concerned about length for backpacking, you can use a single 6' piece). Extend the Wonderpole to its full length, and remove its bottom screw cap. Slide the Wonderpole over the PVC until there is a snug fit, around 1' of overlap. You now have PVC + Wonderpole which when joined together are around 21' in length. Take a 17' 2" piece of light duty wire and twist-tie it to the top eyelet of the Wonderpole with 2" of the wire. I used a non-insulated stranded copper wire which is very light so that it does not weigh down the floppy tip of the Wonderpole. From the top of the pole, measure 16' 8" down and mark the spot, which should be around 9" below the bottom of the Wonderpole. Pre-drill a hole in the PVC and install a small eye screw. Twist tie the bottom end of the vertical wire to the eye screw with 2" of the wire. You should now have a 16' 8" vertical radiator which is just right for the 20-meter CW band. Predrill 4 more holes and install four more eye screws evenly spaced around the perimeter of the PVC ¾" below the eye screw of the vertical element. Using a short stretch of non-insulated wire, short the four radial eyescrews together with few winds around each screw (solder if you like - I didn't.). Cut four 17' 4" lengths of lightweight


THE 20-METER WONDERPOLE
16' 8" of light duty wire stretched from top eyelet of 15' 11" Wonderpole to eye screw in PVC which is 9" below the bottom of the Wonderpole
I.D. of Wonderpole fits O.D. of PVC perfectly! The Wonderpole will slide down the PVC about 12" with a snug fit
Circles are eye screws for radials and bottom end of vertical wire. Front and rear radials are not shown. See text for a description of how radials are connected to eye screws and each other
16' 8" insulated wire
16' 8" insulated wire
6' of 3/4" I.D./1" O.D PVC
plastic tent stake
plastic tent stake

insulated wire (radials) and solder a small alligator clip on one end of each wire, while leaving the other end insulated. Purchase four plastic tent stakes. You are now ready to erect the antenna.

Insert the unprepared end of one of the radials through one of the eye screws and thread the wire through until the alligator clip is near the eye hole. Using 4" of the radial, twist the wire back on itself a number of turns and run the alligator clip back to the eye hole. Pull the radial slightly to tighten and to verify that the strain is on the main wire, not the alligator clip. Repeat this procedure with the other three radials. Twist-tie the insulated end of each radial to a plastic tent stake using 4" of radial. This should leave you with four, 16' 8" radials. With the antenna still on the ground, extend three of the four radials out to their approximate final position (eyeball it) and lightly hammer the stakes in the ground. Raise the antenna to an approximately vertical position and hammer in the fourth tent stake. Unless you are really lucky you will need to readjust the position of the Wonderpole and radials several times to achieve a vertical antenna with radials that are not too slack. With a bit of practice, one person can do this procedure easily and since this antenna is light it can fall without hurting itself or you! Feed the antenna with a short stretch of RG-58 (or your favorite 50 ohm coax) which is terminated on one end with alligator clips. Clip the braid to one of the radial eye screws and clip the center conductor to the eye screw of the vertical radiator. Attach the other end of the coax to your rig, and you're on the air with a nearly perfect SWR, no tuner required!

No vertical antenna with only a few radials is particularly efficient. But I have had some fun QRP QSO's with it and have received/given good reports. It clearly outperforms the shortened 20-meter Hamstick on my car with no ra-

dials. If you want more gain and are willing to use more feedline, then a inverted vee on a 33' DK9SQ mast (weighs about the same as the Wonderpole and PVC combined) is a better option. But if you are satisfied with the performance of a full-length ¼ wave vertical and want a cheap easy solution, then this antenna is for you. The whole system - including the rod, tent stakes, wire, hooks/clips and coax - can be built for $30 or less, depending on your junk box. It can be installed in less than 15 minutes in the field with practice, and collapses to 4 foot (or less) sections for transport. Enjoy!

N6IZ Portable/QRP Vertical Antenna

by Brian Boschma, N6IZ
5291 Country Ln.
San Jose, CA 95129

The concept for this antenna came about with the frustration of traveling and trying to run QRP operations from Hotels. I found it necessary to carry the transceiver, antenna system and a tuner. The tuner was just too much and could be eliminated. With the advent of low cost fishing pools that can extend from 45" to 20' a light weight structure became available. But the missing component was the ability to be able to match shortened antennas for 40 meters and 80 meters with out the need for a tuner or having to carry heavy loading coils. In addition, the loading coil solution has the disadvantage of resulting in impedance's below 50 ohms at the antenna base which then require a matching transformer or yet again the addition of a tuner.

What I hit upon as a solution was a scheme that uses folded transmission lines, sometimes referred to as a linear loads. The key was to make the transmission line adjustable in length so that the reactance can be adjusted for a perfect match. To facilitate this I used a technique that I also employ on my sail boat to adjust the position of fair leads for optimum sail tuning while racing. A bungi chord is used to separate two blocks that are joined by the adjusting line. In the sail boat this is a means to achieve mechanical advantage, in the case of the antenna the adjusting line is replaced with wire and the distance between the two blocks determines the reactance added to the antenna circuit.

Other goals included the ability to achieve a true 1:1 SWR, keep losses low by using large diameter conductors in the matching section and below it where currents tend to be high, keep the components light and easily stowed in a carry on bag, and allow a match to occur in high rise buildings where the abundance of steel in the structure can cause unusual matching challenges.

I opted for an adjustable transmission line that uses a pair of pulleys, a bungi chord, and RG174 used as a large diameter conductor. This matching section is stretched along the length of the vertical. The bungi chord, attached near the top of the vertical, keeps the transmission line pulled taught maintaining a line spacing equal to the diameter of the pulleys. A 4:1 mechanical ratio was used in the pulley system to allow a

folded transmission line with two loops of RG174. The RG174 is only used for its large diameter and flexibility so that it can easily move through the pulleys. Other wires can be used but I would emphasize that smaller diameters are likely to lead to higher IR losses.

construct this device.

Theory of operation:

Refer to the diagrams for clarity. A shorted transmission line open at one end is resonant at frequenices in multiples of a ¼ wavelength. Between these frequencies it exhibits capacitance or

Parts List

Bungi chord length: Approx 6 ft of ¼", Suggest Marine Grade
RG 174 for transmission line matching section: 50 ft (for 80 mtr, 40 ft is ok for 40 mtr)
Fishing pole mast: Black Widow, order from Cabellas
Gnd Plane: 2 35' lengths, for 80 2 66' lengths
Pulley 2 two shieves: West Marine – Harken model #
Pulley 1 one shieve: West Marine – Harken model #
Driven element: 16 ft RG 174, clip lead at both ends, shorted braid to center
Folded transmission line matching section:

The transmission line is constructed of a continuous length of RG174 that is used for its outer conductor diameter. The Center of the coax should be left open or shorted to the braid at both ends. The length of this should be about 50 ft. The 174 passes through a pulley that in effect sets the spacing of the transmission line. What has been created is a transmission line that is shorted at one end (where it passes through a pulley) and open at the other where it is driven by the feed line and drives the vertical whip section of the antenna. Two additional pulleys, or rather a double block (two shieves mounted in the same housing) forms a fold in the transmission line so that the effective length is reduced from 25' to 12.5'. It is important that the matching section not be wound as a large coil but rather as a transmission line folded back upon itself. If you create a coil, all wound in one direction, you will be unable to achieve reliable and efficient match's. Refer to the included diagram for a picture of how to

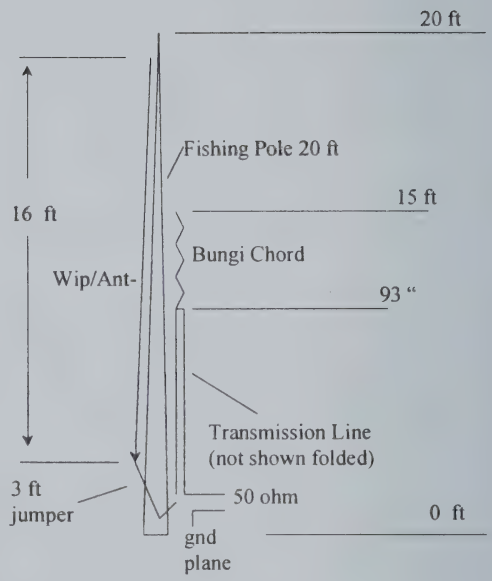
inductance reactance. If a vertical whip is too short then it is necessary to add inductance to reach resonance, if a whip is too long capacitance needs to be added to effectively shorten it. These lumped inductances on shortened antennas are usually implemented using loading coils. Loading coils work but in order to make them adjustable require a means of tapping at any point. This usually results in a heavy mechanism to form an adjustable coil.

The reactance exhibited by shorted transmission lines is used widely in antenna design. Examples are a gamma matching section on a yagi, the impedance transformation ¼ wave section at the bottom of a J Pole (the J part of the J pole is a open line driven at or near the shorted end then connected to a ½ wave whip), and the traps used in KLM yagis and GAP verticals, to name a few.

What has been arrived at in this case is a means to allow adjustment of the length of the transmission line and thus adjust the reactance to achieve a match at various frequencies of interest

N6IZ Portable Vertical Antenna Construction

Shown is general setup for 40 mtr operations.



Bungi attached with tie wrap loop.
WIP attached with clip leads
Pulley at base connected with tie wraps
Dual pulley at top tied to bungi
Transmission line is stripped back at tap points as needed.

to the amateur. In the case of 40 meter operation, that is described here, the whip section is at most 20 feet long and thus needs additional inductive reactance to achieve resonance. This is done by adding a transmission line approximately 20 ft long folded back against itself so that the matching section only constitutes 10 ft of antenna mast height. The folded transmission line runs up and down the mast as does the driven whip . Thus the 20 ft mast supports both the 20 ft whip and the 10 ft of transmission line.

The characteristic impedance of the transmission line is controlled by the spacing of the conductors and their diameter. In this case the diameter is that of RG174 and the spacing is somewhat uncontrolled since there are no spacers as in ladder line. I have found in operation that as long as the spacing is not varying too much over the length of the section the match is very stable. However, the abililty to alter the characteristic impedance leads to another means of fine tuning the match of the antenna. One can add a spacer that opens the line up and increases the Zo of the line. The resulting reactance is proportional to Zo and increasing the spacing increases Zo. The net result is that widening the spacing and forming a diamond appearance with the folded transmission line can dramatically lower the resonant point. I have used 12 inch to 30 inch spacers located 8 ft up the mast of the antenna. In doing this I can lower the point of resonance by as much as 1 Mhz when operating at or near 80 meters (< 4 Mhz.). You will find that this is a reasonable approach to tuning the antenna for a perfect match.

Another phenomenon that must

Transmission Line Adjustments To Accomplish Matching

Za= jZo*tan (Theta)

This equation shows the reactance that results when using a transmission line as a lumped element to match non resonant verticals. Theta = angle of electrical length, 1/4 wave = 90 deg.

Zo = characteristic impdance of transmission line.

From the above one can see that there are two ways to adjust Za, the reactance. Lengthening the transmission line increases Theta and increases Za. Altering Zo also has a similar effect.

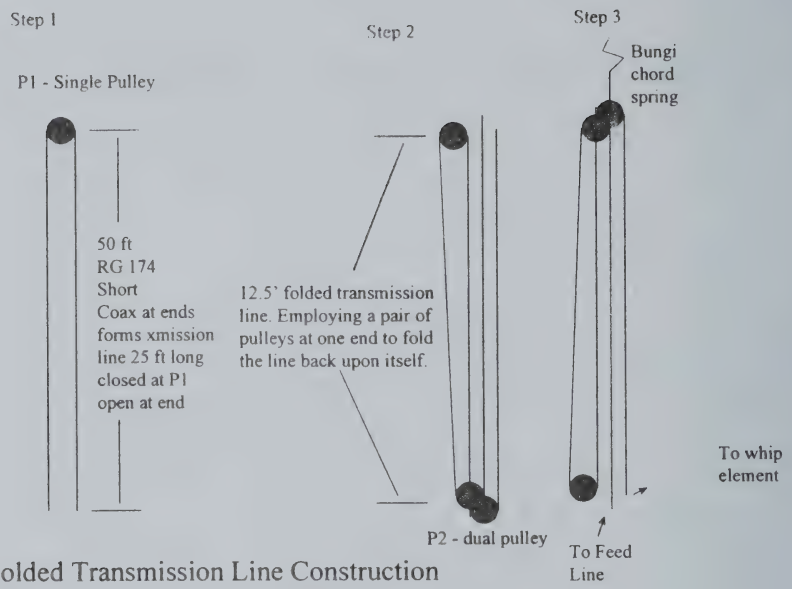
Spreaders alter Zo, distance between pulleys alters transmission line length. Both techniques are used to accomplish matching on multiple bands in this antenna.

← Spreaders applied to alter characteristic impedance of transmission line.

be accounted for is the greatly reduced real portion of the impedance (much less that 50 ohms, simulation shows 6 ohms for this case) that is remaining after cancellation of the imaginary capacitive reactance for a shortened antenna. The folded transmission line in proximity to the driven element accounts for this. The transmission line a distance away from the driven element would only be able to cancel the antenna's capacitive reactance. Since the driven element is close to the folded transmission line the conductors of both contribute to the total field that comprises the electromagnetic field in the botton half of the vertical. This really means that the sum of the currents in all wires make up the current that creates this field (field is proportional total current, B =n*I, I = I1+I2+I3+I4+I5 for 5 conductors). One can see that while a single conductor would have a very low impedance with 5 conductors the total current is shared thus reduced in any one. Since only one conductor is driven at the end of the folded structure the current is reduced from the case of driving the driven element alone and thus the real resistance is raised well above 6 ohms (from simulation). The amount of sharing is greatly dependent upon the spacing between the transmission line wires and the driven element. So one can add yet another axis of adjustment to experiment with by tilting the transmission line away from the driven element.

In Operation:

The mast is erected with a 16' whip at the top, the bungi chord attached



Folded Transmission Line Construction

about 3 ft below the top, the matching section attached 12" from bottom on the fishing poles clip and tied to the bungi chord at the other end, and the feed line driving one end of the transmission line. The transmission line is then tuned by pulling the end that attaches to the feed line to the desired length and then the outer braid of coax stripped back to expose an area just large enough to make good contact with the clip leads on the feed line. In the case of 40 meter CW I have good results with 93" seperating the pulleys or about 31 ft wire (15.5 ft of transmission line, 7.5 ft of folded transmission line). In this case I achieve a match of 1.05 to 1 when connected to two 33' ground plane wires.

For 80 meters operation I have found that the length of the folded transmission section needs to be near 12 ft. Then with application of spacers as mentioned above one can readily tune the design to 80 mtrs. I have used two spacers 18 inches long each seperating the opposing leads of the folded transmission line. This results in a pair of diamonds on orthogonal places in place of parallel transmission lines.

In two recent events with other operators joining me in the field I have seen really good results when compared to other antennas based around the 20' fishing pole. At field day and the recent Bubba QRP contest there were Saint Louis veritcals present, some with matching coils. On 40, 20 and 15 I was able to achieve a match typically below 1.6 : 1. With the best on 40 meters at 1.01:1. QSO results also demonstrate the strength of the antenna as I had no problem working anything worked by the other stations and was able in some cases to work those that others missed. When compared to antennas using large loading coils on 40 meters I achieved excellent match without a tuner. The

loaded antenna's were unable to get a good match on 40 without using a tuner (the loading coil only compensates for the capacitive reactance, not the lowerd resistance at the feed point; in addition the high currents that flow in the coil and possibly the mismatch of 50 ohm coax to the tuner result in I R losses). Another interesting aspect is the ability to change bands without lowering the antenna. For 40 the matching section is in use as an inductor and transmission line transformer, for 20 the driven element at 16 feet is driven without the matching section in place, on 15 the matching section is now used as a capacitive reactance and a match is achieved again.

Hope you enjoy this ariticle and the antenna. Once the thing is mastered you will find it works quite well.

Characteristics:
Bandwidth on 40 mtrs: 1:1 swr at 7.050, 1.5:1 at 7.339 MHz.

Blueprinting / Modifying the Norcal NC20

By: Gary Surrency AB7MY
Email: gsurrency@juno.com

Presented at the Ft. Tuthill QRP Symposium, 1999.

Since the initial introduction of the NC20, there have been a number of changes and improvements to the original circuit. As one of the beta testers, I have had the opportunity to try some ideas on the prototype and then compare it to the unmodified final kit for evaluation. I am quite pleased with these modifications. The intent here is to put the mods in a single document that can be used by all owners of the NC20.

I've organized the mods in a fairly logical order, starting with the receiver and proceeding from the antenna jack through the radio to the speaker output. Similarly, mods to the transmitter begin with the VFO stage, and end with the RF output at the PA stage. Some observations are noted at the end that really are general in nature and don't fit into any specific stage, per se'.

Receiver Mods:

David Meacham, W6EMD, originally documented these mods. I have included them here for completeness, and with permission from Dave.

Begin W6EMD Mods:

1. The secondary of T2 should be changed to have 3 turns, instead of 4 turns as specified in the original circuit. This improves the impedance match to Q5, permitting a better transfer of signal to Q5.

2. A 220pf monolithic or disc capacitor should be added in parallel to C22. A better match to the input of the TFM-2 diode dbm is thus accomplished, and a sharper peak of trimmer TC5 will be noted. It is perhaps easiest to add this cap on the PCB bottom, using as short of lead length as possible. Re-align TC3, TC4, and TC5 after performing this mod and the one above.

3. The crystal filter as designed is pretty good. But if you crave a sharper bandpass, then the following changes, (also from W6EMD) can be made.

a) **Revised crystal filter:** This mod gives a narrower bandpass, much better match, and 2dB lower insertion loss. The only penalty is a rounded top on the response curve...you hardly hear it. Change the capacitor values to the sequence 1200pF, 680pF, 1200pF, 680pF, 1200pF (C30 through C34).

Return loss = 23dB
Insertion loss = 7dB
Bandwidth = 480Hz @ -6dB points

b) **Revised roofing-filter:** This mod centers the response curve better on that of the main filter. Change C38 and C39 to 820pF. On the underside of the board cut the trace between C36 and the emitter of Q8. Scrape off the solder mask on each side of the cut, and solder a 120 ohm resistor across the cut.

[To avoid cutting any trace, I suggested lifting one end of C36 and soldering the 120 ohm resistor in series with it (above the board).] – AB7MY

To save some money, Dave Fifield suggested using the two 680pF caps removed from the roofing filter for the revised main filter, and the two 820pF caps from the main filter for the new roofing filter. He also suggested simply adding three 390pF caps underneath the PCB in parallel with the remaining three 820pF caps of the main filter to bring them up to 1210pF instead of having to replace the 820pf's with 1200pf's.

c) **Hiss fix:** This mod kills the hiss from U6, but is useful only for headphones. Cut the trace (on the underside of the board) from C62 to J1 (close to C62). Jumper the cut (as above) with a 39 ohm resistor. Add a 22uF tantalum capacitor from the hot terminal of J1 to ground (negative to ground). Change R56 to 10k ohms. (This is a refinement of the mod mentioned in the manual.)

End W6EMD Mods

4. The 2N5179 transistor used for the post crystal filter amp at Q7can be replaced with a MRF904 from Tech America. This part has a very low noise figure, and it helped to improve the S+N / N ratio. Buy several of them while you're at it so you can have some for future projects. Pick the quietest one by trial-installing it before soldering it in. Q8 is not as critical to the NF, so it may be left alone.

5. Dave Fifield, AD6A, designed a mod to vastly improve the AGC action, over the rather abrupt behavior of the original setup. I have repeated it here for you convenience:

Begin AD6A Mods

a) Remove and discard the following components:

R19, R20, C20, D9, D19, D20, D21 and C65. *see note below

(Put them in your junk box for future experiments)

b) Put a wire link where D9 was fitted.

c) Change R29 to 3.9K (was 2.2K).

d) Change R60 to 2.2M (was 4.7M).

e) Change C63 to 0.47uF (was 1uF).

f) Fit a new 2.2K resistor under the

PCB from the junction of T4 and U4 pin2 to the AGC2 signal at R41. If you solder the resistor at the point where the wire for T4 comes through the PCB to the point where R41 comes through the PCB, you should be able to fit the resistor horizontally with almost no excess wire at either end (nice short leads).

g) Fit a new 680 ohm resistor in C65's position on the PCB.

h) With your digital multimeter, measure the voltage at pin 2 of U4. With no signal input to the RX, adjust VR5 for exactly 1.4V at U4, pin 2.

<<<<End AD6A mod>>>>

· If after performing this mod you have a loud "whoop" in the RX audio on key-up, you'll need to do what I did to solve that annoying problem. Re-install the PIN diode at D9 along with its associated bias components. This will allow the AGC to reduce RF gain sufficiently during TX mode, so that the NE602 at U4 does not get clobbered by the strong TX leakage into the RX front-end and IF stages. One of my rigs was more affected by this problem than the other one, but I still left D9 in to avoid future problems with TX leakage into U4. This problem is worse at TX levels of 4-5 watts, as you would expect. Lower TX output levels may not produce such disturbing T/R pops. There is very little signal loss with the PIN diode installed instead of the wire jumper Dave mentions, so perhaps it is best to just leave D9, and its biasing resistors installed.

6. The AGC threshold voltage tends to drift considerably in the original design. Larry East, W1HUE/7, posted a cure for this on the QRP-L. Basically, a 1N914 or 1N4148 diode is inserted between the base lead of Q12, and resistor R63. The easiest way to wire this into the radio is to clip the folded-over lead of R63 to about 1/8". Solder the diode's anode to this short lead, and insert the cathode into the hole that goes to ground. I changed R63 from 1k to 1.5k to allow VR5 to end up near the middle of its range when the AGC setpoint was correct. On the other NC20 I have, it was necessary to use a 1.8k resistor. The slightly higher resistance also allows for a bit more AGC action, since Q12 effectively "sees" more of AGC voltage developed across R62. The proper setting of this threshold is when the voltage at U4's pin 2 is at exactly 1.40 v. This is the correct bias on this pin without any AGC control applied. With the AGC mods by Dave Fifield just presented, about 6.0 volts will be seen at the top of R41 (a convenient test point for your DMM). AGC voltage drift was reduced from several 10ths of a volt at the 6.0 volt AGC line, to only 70-90 mV over an hour period of warm-up. There is even less change measured at U4's pin 2 bias setting of 1.40 v, due to the 2.2k / 680 ohm resistive divider.

7. Some of the MPF102's used in the kit, have excessive leakage when biased off. This may cause the FET mute switch at Q9 to misbehave, causing an annoying pop during the T/R transition. I used a J309A in my kits to correct this. This FET had a much higher Rds_OFF resistance when measured, plus it also had a desirably low Rds_ON value when conduction. Some folks have used a 2N5457 at Q9 and also at Q1 in

the VFO for the RIT switch. But I prefer the J309A myself.
8. If you prefer a lower CW note than the approx. 700 Hz in the original design, then you may want to change a few resistors in the active audio filter. After some email exchanges with Dave Fifield on this topic, here's the scoop:

f=500Hz: R53 = 4.7K (was 3.3K), R54 = 8.2K (was 6.2K), R55 = 330K (was 220K)
f=600Hz: R53 = 3.9K or 4.12K 1%, R54 = 7.5K or 7.32K 1%, R55 = 270K or 267K 1%
F=650Hz: R53 = 3.9K or 3.83K 1%, R54 = 6.8K, R55 = 240K or 243K 1%

I chose the values for 600Hz. This is a convenient frequency, since the TiCK sidetone is very close to 600 Hz. I used 5% carbon film resistors, but first checked them with a DMM for value. Be sure to re-adjust the BFO trimmer at TC6 to put the IF signal in center of the new AF passband. It is best to disable the AGC at the pads provided, and connect an AF analog voltmeter (VOM) to the speaker output. Tune in a signal from another source, such as your big rig operating into a dummy load at low power. You may need to make small tuning adjustments to get this signal in the center of the IF crystal filter. The RIT control on the NC20 is handy for this. Tweak the trimmer and tuning on the NC20 for maximum AF voltage on the VOM.

If your big rig's sidetone and offset track each other, set it to match the new frequency of the NC20 AF filter, i.e., 600 Hz in my case. My TS-570D does this, as do most modern transceivers. Key the big rig, tune in the signal on the NC20, and adjust the trimmer at TC6 for maximum audio output at the new audio filter frequency. An audio frequency counter can be attached to the top of R58 to help set the BFO for the same sidetone as the big rig's setting. Once you have the RX BFO set, you need to adjust the TX BFO to keep the offset correct. Without touching either the big rig or the NC20's tuning knob, key the NC20 and adjust TC7 until the beat note between the NC20's TiCK sidetone and the received signal pitch on the big rig match. Unkey the NC20, and key the big rig again to check if the sidetone from the big rig and the audio tone on the NC20 are matched. Adjust the volume levels if needed. Repeat this procedure until you are satisfied. End of Receiver Mods

Transmitter Mods

8. The VFO on many NC20's chirps a little. Mostly this is due to the type of 78L08 3-terminal regulator used at U2. Replacing this device with a brand new L78L08ACZ from SGS Thompson usually cures the chirp. Dave Fifield will replace the faulty ones if you send him return postage. Note however, that excessive voltage drop in the power cord and DC connector can also cause voltage droop (as opposed to just voltage drop) during keying, so use at least an 18 gauge power cord and be sure the DC connector fits tight and is clean. Let's not have any chirpy NC20'S!

9. Because the RIT control has a detent at the center, it sometimes is difficult to tune in an off-frequency signal that is close to the detent. Reducing the RIT range helps, since the knob must rotate further from the detent to produce sufficient frequency change. Merely plac

ing a 3.3k to 10k ¼ w resistor right across the outer terminals of the RIT control is an easy way to accomplish this. Everyone has their own preference for how much RIT range is best for their operating style. So experiment with several values and pick the one that's right for you.

· I decided that a 4.7k value produces the range I like, but I did something else. I also changed R5 from 330k to 820k. Along with the J309A FET for Q1, these changes game me the RIT behavior I prefer.

10. If the VFO output is low, both the TX and RX performance will suffer. If a new J310 for the VFO oscillator does not help, then look at Q3 and / or Q4. I found I had to replace the 2N5179 at Q3 to get good VFO output. It's best to cut it out to prevent damage to the PCB, since it has four leads. If you have the 2N5179 still intact from replacing it at Q7 with a MRF904, you can try that one at Q3. Do not substitute a MRF904 for Q3, however. I found it performed poorly compared to the 2N5179 in this circuit. Check the VFO output at Q3's collector for improvements in RF output, since the diode dbm clips the RF level at the point labeled on the schematic as "LO+7dBm" to around 0.280vrms. You won't see a change in RF level at that point, unless it is below that level. At Q3's collector, you should have >1 vrms of RF if using an RF probe. I have about 1.50 vrms on my rigs.

11. I reduced the VFO's tuning range to about 72-73 kHz by placing two 100k resistors in series at R9. Insert each resistor straight into the PCB pads, and then bend the top leads together and tack solder them. This gives the desired 200k, which is not a common value.

12. Low TX output can be a result of a lot of things. First be sure that the TX bandpass filter at T5-T6 is tuned properly. There **has** to be two peaks on trimmer TC8 and TC9. If not, then check the number of turns on the toroids, or C70 and C71. Some trimmers have been noted to be bad, so they are also suspect. But if their maximum capacitance is merely low, then add a turn or two to the toroids to compensate. Tune the BPF trimmers with the TX output reduced to 1-2 watts for the best resonance reading. The bandwidth of this BPF does vary a bit over the rig's tuning range, so tweak the trimmers near your favorite frequency if you like. Low output from the TX BFO and BPF may be corrected by adjusting the size of C14, but keep it in the 8 to 15 pf range. Excessive VFO drive into the NE602 at U7 will cause it to produce more spurious output than the TX BPF can filter out. If the 8-15pf capacitance at C14 doesn't help low TX output, then the problem is elsewhere.

13. Assuming the TX BFO, BPF, and pre-driver / driver stages are functioning well, then low TX output may be the result of a PA stage fault. Do not increase the value of the 22 ohm resistor at R80, since extensive tests during the prototype stage indicated this low value is critical to good PA stability. Instead, look for a problem in the PA's lowpass (LPF) or associated components. Occasionally, a defective 2SC1969 is the cause. But more likely, low TX output is due to a bad component or error in the LPF.

· You can use an antenna analyzer to examine the PA output stage and its

LPF. Attach the analyzer to the antenna jack, and disconnect the DC power. Temporarily place a test resistor of 15-19 ohms across the PA Collector and Emitter leads. The value to use is approximated by the equation:

R_collector= (Vcc x Vcc) / (2 x P_out)

- For 13.8v and 5 watts, this works out to ~19 ohms. Use a 18 ohm ¼ w resistor, or two 39 ohm resistors in parallel. For 12v and 5 watts, it is 14.4 ohms. A 15 ohm resistor is fine.
- Set the analyzer to read RF resistance and reactance. Sweep the frequency on the analyzer around the 20m band to see if you can get near to a 50 ohm match, with low reactance. With the analyzer set to 14.060 MHz or thereabouts, carefully adjust the windings on L6 and L7 to achieve the best match. On my rigs, the best match occurred with the windings on L7 spaced around the upper half of the core. L6's windings are evenly distributed around the entire core.
- If your LPF just won't allow a good 50-ohm, low-reactance match – then you might try the alternate LPF values Dave Meacham determined. He used 8 turns on L6 and 7 turns on L7.Changing C80 to 300pF (two 150pF caps in parallel), and omitting C82 increased the output by 0.1W. Evidently, there are considerable variations in type-2 core material, but the analyzer will help you determine and correct this if it is true.
- Don't forget to remove the test resistor before applying power to the rig! Remove the antenna analyzer, too. Do not transmit into the analyzer!

14. I altered a few components around the keying transistor Q20 to change the keying characteristics. I had noted a difference between the rise / times of the RF envelope, and I also wanted to shorten the rise / fall times slightly to improve the keying at higher speeds. These changes consist of replacing R85 (1k) with a 510 or 560 ohm resistor. R84 (4.7k) is changed to 3.3k There is often too much voltage drop across the 2N3906 at Q20. More than 90-100 mV is reason to change it to a 2N2907A, MPS2907A, 2N4403, NTE159, etc. If Q19 and Q21 do not go into deep saturation during TX, or have much more than 60-100 mV from its collector to ground, replace them with another transistor of the same type. Or use a MPS2222a, 2N4401, NTE123A, etc. This insures good keying, fast muting, and silent, rapid, T/R switching. End of Transmitter mods.

Notes, comments, etc.

I have noted that the small, epoxy RF chokes should not be mounted tightly against the PCB, as this will cause adverse affects in the associated RF circuit. I found this behavior when I was adjusting the RX and TX BFO's, and also the T/R circuit at L2. I recommend leaving about 3/32" to 1/8" spacing between the bottom of the RFC's and the top surface of the PCB.

The Main Tuning knob does not go all the way on the shaft of the ten-turn tuning pot. Instead of cutting some off of the pot's shaft, check the bore of the knob for flashing that interferes with sliding the knob all the way on. A little help from a ¼" drill bit cured this problem on my rigs, but don't drill too deep and out the front of the knob!

If your rig performs as well on receive as mine, you may want to increase

the value of R56 from 33k to 47k or 56k. This makes the audio gain control require more rotation so that the volume isn't too loud right off the CCW stop, or when using headphones.

When using Doug Hauff's anodized custom enclosure, it is difficult to get a good ground contact to the solder lug under the RIT control. I finally removed the front panel from the rig and masked the hole with a large flat washer using some tape. I then sandblasted the anodized coating away. The anodizing is extremely hard, and scraping it or using a toothed lockwasher does not work well. Perhaps someone has another way to remove this coating that I have not thought of. The front panel needs to be well grounded to prevent hand capacitance effects on the VFO, and also to insure good RF shielding.

Try these mods on your Norcal 20. Your feedback is welcome, and I hope your rig performs as well as mine do. 72, Gary, AB7MY

How to Contest, QRP Style with QRO Results

by Jay Bromley, W5JAY
1915 Bryn Mawr C
Ft. Smith, AR

Doug Hendricks asked me to do a piece on contesting. I don't know how he does it, but Doug has that ability to get people to write articles. I don't profess to be a writer, but I will try to do my best on a difficult subject. To write about contesting can be an endless subject, so I am going to focus on my favorite contest, The ARRL SSB Sweepstakes! First, let me describe myself as a QRPer that likes to dabble in contests instead of a contester who likes to enter QRP categories. I also contest in the CW mode, but I feel I am not good enough to run stations, yet! So, I rarely turn in a log in the CW Sweepstakes contest.

My start in the Sweeps using sideband was purely accidental. I was at the local Saturday breakfast back in 1997, talking up the latest QRP craze, when someone announced to the group "that all this QRP stuff is only good for the CW mode and not for SSB". Two of my good friends and heavy duty contesting freaks, Jerry AB5SE and Steve K5OY were there. Jerry and Steve had already asked earlier if I was going to work the Sweeps that weekend. I told them I might spend a few hours working the Sweeps. Up until this point I had only worked a few 160 meter contests, but never a full all out effort. The individual that proclaimed that QRP was useless to anything but CW had thrown down the gauntlet. I changed my mind as to how I would work the contest mainly to make him eat his words later. I just wanted to see how many states I could work and maybe win my state. I made a half-hearted effort and worked the contest 8 hours. I scored a whopping 32K and sent my log in to be checked. I forgot about the contest and the individual who prompted all this.

While coming back from Dayton/ARCI 4 days in May, I called Steve, K5OY, to tell him about the great time I had in Dayton and also how neat it was to see some of the well known QRPers receive awards at the awards banquet. Then Steve said, "You're going to receive an award yourself. You won the ARRL Sweepstakes in Delta Divi

sion!!" I didn't realize it at the time-how hard these plaques were to get. A few weeks later, while Steve and I were chatting about contests, Steve said there was some scuttlebut on the web about my score being low and it wouldn't happen again. Several contesters saw the low score and now had their sites set on getting their own plaque. My response was "I will put in a full effort to see if I could get another of these neat plaques to keep my other one company." Deep down, I admit that I use this for an incentive to do better than my last outing. While I didn't win another plaque this last year, I almost doubled my score and finished third in Delta Division.

OK, so now you know one of my secrets. You need an incentive to push yourself to do your best. The next thing you need to do is to evaluate your station, its weaknesses and strengths. As an example my station does well on the following bands —15m, 20m, 160m. It is OK on 75m, but weak on 10m and 40m.

You also need to look at the competition's station, if you can. How in the world do you do that when your competition is states away? Well, I use the Internet and word of mouth. I do searches on the contester's call. Most of the biggies love to show off and why not? They're the best, just daring you to take a shot at them. I mention word of mouth There is no better place than the QRP forums and hamfests. This summer at HamCom when the gang went out for dinner I ended up at the same table as Jim Duffey, Wes Spence and Chuck Adams. Later that night I was picking the brains of some of the Houston Big guns like Bill Steitenroth, K5ZTY.

OK, now you know where your station is compared to your competition, what's next? Go to forums like the one at Fort Tuthill with Ron Stark and Chuck Adams. Every time I listen to these guys I learn something new. Subscribe to magazines like the National Contest Journal. This contest stuff is like most sports, it is more mental than physical. Learn, learn, and learn.

Now on to some of the basics before we go on to some of my unorthodox stuff. Most of these have been repeated a hundred times in magazines like NCJ. Get your computer up and running a week before the contest. Make a trial run if you can before the contest to make sure all your equipment is in working order. If you can, take the day off before the contest to relax and to fine tune your station. Start on time on a band that is strong for your station. If you are using a wire and can't get a run going, then it is time to hunt and pounce. Don't stop and don't get discouraged, keep going. One thing I learned from Ron Stark is that winners keep going even though it seems hopeless. Remember you have a couple of handicaps with QRP and SSB.

Before the contest check out your audio with a friend on 10m. Hums and distortion are a no-no. If your rig is capable of running QRO, run it before the contest and get the nasties out with high power so you won't have any problems at the QRP level. I set my power up to 5 watts on a calibrated watt meter and then set my scope up so that the signal is just below the top and bottom lines. This is my reference. Even though I have several peak reading watt meters they just aren't accurate enough for SSB. All I have to do is glance at the scope to know I am QRP legal and ready for any ARRL official to verify my sta

tion, grin.

I run 5 to 10 dB of compression and I also change the set up in my TS-950SDX from Hi-Fi to War mode. This is a DSP adjustment where I roll off the low end frequency response from 100hz to 3100hz. I leave the high end alone at 3100. My main goal here is to sound like I am not QRP. After you think you have your audio set right, go back to 10m and have your friend attenuate your signal as low as possible. If the results are loud, clear, and you are easy to understand, you are ready to go. I learned from my friend, Fran Slavinski, KA3WTF, mentally you are not QRP, but think and act like you are a 100,000 watt short wave station. In other words no wimpy sounding HC-4 element here. Restricted microphones like the HC-5 are OK but don't go running narrower than this. I am presently using a boom mic with Sennheiser HD545 headphones. The Heils started to hurt my head during the first contest I used them and that's why I am using the Sennheisers now.

You have to be comfortable all the way though the contest to do well. Don't forget a good chair, monitor at eye level, and controls easy to reach. Also, I would recommend a good voice keyer because when you get tired, you make mistakes and you don't want to have broken calls and have points taken away from someone else's logs because of your screw ups. Last year, after hearing one of the station's calls phonetically, I started using his call instead of mine. I don't know if it was the fatigue or what, but I finally had to stick a post-it-note on the computer monitor with my phonetics, so I wouldn't mess up. My error rate was just under 3%. It seems that most of the low power stations were around 2% and the high power category were under 1%. You should strive to be as good as the higher power categories. Accuracy is as important today as making contacts. It is better to slow down and not make mistakes than to run a high rate with errors you will be penalized for.

Most serious contesters recommend to not be too chatty and do away with "PLEASE COPY" along with the report. In other words, no wasted motion, as it separates winners from losers. This is one of the areas where I break the rules You will have to decide for yourself if these tactics will work for you or not. For example: Last year, I wasn't able to get any runs going the first day. My second day, early in the afternoon, I had a score that didn't match the previous years' plaque winning eight hour effort. That is when I went to 15m, found a hole, and started calling CQ contest. I got a little mad and kept banging away and soon, I had a pile up going. Now I had the rate climbing and quite a few cheerleaders, when they found out I was QRP. Every time there was a comment on my signal was good for QRP, I would beg them to send other operators, even the ones not in the contest for a contact. It wasn't long before I made up for lost ground and started passing some of the other QRP stations. I then swung the beam up to the northeast and begged again. Obviously if you're a big gun and your rate is over 200 you would not be doing this. But when the chips are down you look for other ways to score points. When calling CQ contest and the rate is on the down side, I sometimes throw in QRP in the end to attract operators that might think I am too weak to be worked or that I might

be back scatter. It is tough living in the Midwest and using the beam because you are leaving out half of the country and you have to use tricks like these to attract contacts, unless you have a switched antenna array instead of a rotator.

Another favorite tactic I like to use and did after my 15m run. I went to 20m and found the loudest signal I could at the low end of the band. I got as close as I could to him and still be able to copy stations. I like to call this the mosquito effect, because he doesn't know you are there and you're getting his over flow. Stations on his side of the country don't hear him, but will hear you. If he is a rare state and is spotted up on the cluster, again it is to your windfall. To do this type of operating takes serious receiver and lots of practice. I also recommend using high quality headphones with the volume turned down, to lessen the fatigue. I use all the crystal filtering and DSP that I can stand and still hear stations through the other station's monkey chatter. This is where all those nights chasing those 40m foxes, pay off. Listening on sideband is just as much an art form as it is for a high speed CW operator. I've had great CW Ops guest my station and work a little sideband DX. It is funny how I can hear the DX stations call my guest though the pileup before the pileup has died down. I tell them to go ahead and make their call when they never heard it. They usually freeze until the DX station makes another call for them after the pileup has died down a little. What it boils down to again is to learn, listen, and improve. Don't be afraid to experiment because every station has its own limits so you have to adjust accordingly.

So, now that I have done all this blabbing, what am I going to do to improve my station in this year's contest? The most important thing for me would be to get rid of the sloper on 40 meters and get some sort of directional array on that band. This is going to be hard to do considering I live on a city lot, and I am limited to what I can do. I use my tower as a shunt fed for 75m and 160m even though these bands haven't contributed much to my score, I am pretty effective here even at the QRP level. One thing I can do is add a voice keyer and play like I am K7RAT with monobanders at the start of the contest. See if I can get some runs going early. That way I can chase the last sections like Yukon in later hours. I missed Yukon last year and I was hearing Jay stand by for QRP stations, late Sunday afternoon. I guess this is the mark of a true contest QRPer. The power control looked tempting, but it stayed put and I missed Yukon. The other thing I wish I could do is to have a switched array so I could go two directions at once. This is something that is not practical at the QTH. The stations on the corners of the US have it made because they can pretty much point the beam in one direction and get most of the sections without wearing out their rotor. The beam I use is a highly directional log periodic which is great to minimize interference off the side and back, but sometimes you wish you could work off the back or side with the flip of a switch. When I first bought this antenna, I was interested in getting a little gain 20 through 10 meters and providing a lot of top loading on the lower bands for the slopers and shunt feeding. I wish now, I could go to some sort of monoband set up on all

bands. But again this is not practical being in the city.

So there you have it. How to analyze your station to be affective against the big guns. I am convinced that no matter what station you have, you can be competitive if you look at the limits of your station and not necessarily follow conventional wisdom as to what is possible without the hardware. I am not sure I will ever be successful again, but, you can be sure, I will be in there giving it my best shot.

Hope to cu in this years Sweeps!!

73 de W5JAY..

THE NORCAL 20 GOES DIGITAL

by Bill Jones - KD7S
kd7s@psnw.com

When Dave Fifield (AD6A) designed the NorCal 20 he had the foresight to make it digital compatible. He placed pads on the PC board to pick off audio, key the transceiver, and even add frequency shift keying. The addition of a simple, homebrew interface and a shareware computer program transforms this venerable little CW transceiver into a lean, mean RTTY machine. Dave's engineering is only half the equation. Credit for the other half goes to W. F. Schroeder (DL5YEC) who created the software, HamComm. Besides RTTY, HamComm sends and receives AMTOR and keyboard CW. The registered version even copies Pactor transmissions. HamComm can be downloaded from any number of sources on the Internet. By far the best is Terry Mayhan's AUnofficial HamComm home page@ at http://home.att.net/~k7szl/.

The interface consists of a handful of common parts, most of which are available from Radio Shack. I built the prototype on a small piece of perfboard and mounted it inside my NorCal 20 cabinet. The transceiver requires no modifications beyond mounting the DB-9 connector on the back panel and connecting four wires from the interface to the main NC20 PC board. Normal (paddle generated) CW operation is not affected.

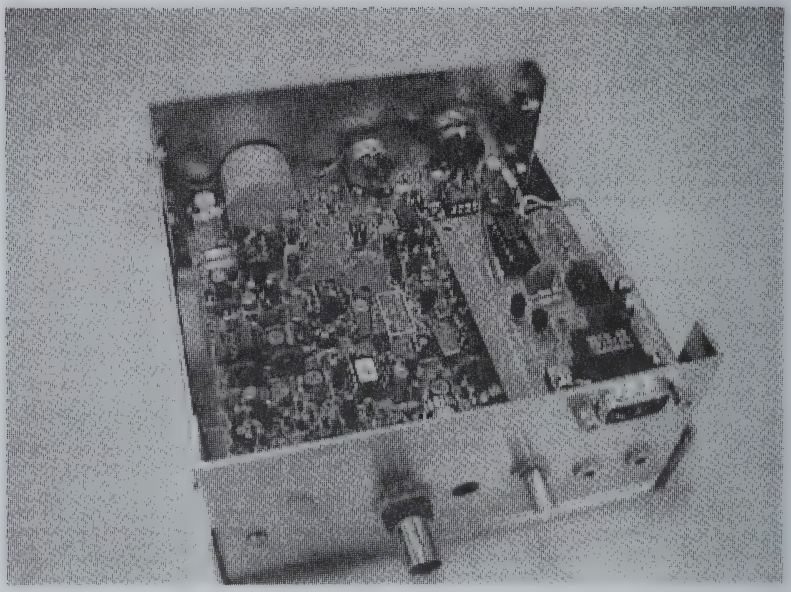
RTTY BASICS

Radio Teletype (RTTY) uses two different tones for data transmission. These tones are spaced 170 Hz apart. One tone is the Amark@ and the other is the Aspace.@ Characters are created by manipulating the mark and space tones in predefined patterns using a 5-bit (Baudot) code.

A common way to generate the RTTY characters is to feed audio tones to the microphone input of a SSB transmitter. This is known as AFSK or Audio Frequency Shift Keying. In the case of the NorCal 20, the transmit frequency is rapidly switched up and down by 170 Hz to achieve Frequency Shift Keying, or FSK for short.

A CLOSER LOOK AT THE INTERFACE

Decoding incoming FSK signals begins by feeding audio from the NorCal 20 to the non-inverting input of IC1, a TL071P Op-Amp. The audio is taken from the junction of R59, D19, C55 and R56 on the NC20 main board. There is a pair of pads marked AR/C@ situ



NorCal 20 back panel showing location of DB25 Connector

ated between the a.f. Gain (VR4) and RIT (VR2) controls which were designed just for this purpose. Use the right hand holeCthe one closest to VR2.

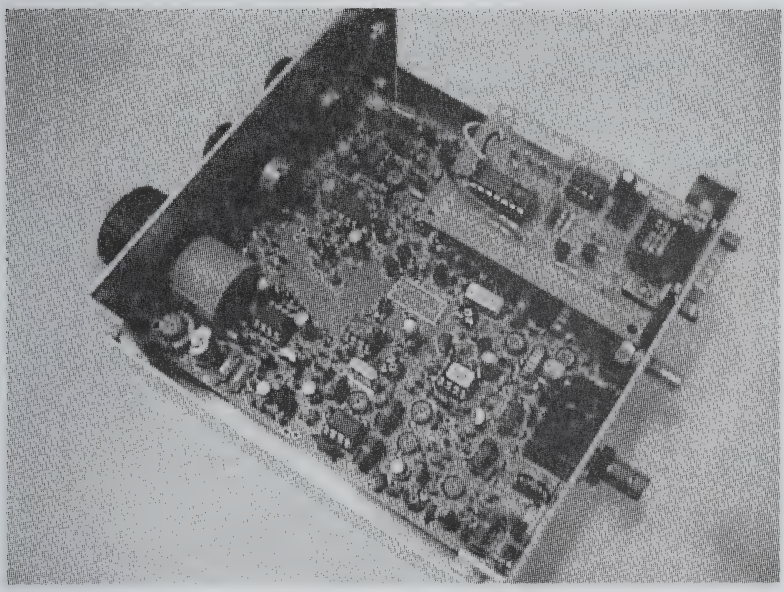
The receiver is tuned so that the incoming RTTY mark and space tones are equally spaced above and below a user selected center frequency. I chose 725 Hz to take advantage of the narrow CW filters in the NC20. Pin 6 of the TL071P outputs either a positive or negative going voltage depending upon whether the incoming tone is a mark or a space. The HamComm software then translates these changing voltage levels into the appropriate ASCII characters and prints them to the screen.

Switching to transmit uses a different part of the interface. The first thing that happens is that the software drives the base of Q1 positive which keys the NorCal 20. The collector of Q1 is connected to the pad marked AK@ on the NC20 PC board.

As characters are typed onto the computer`s keyboard the software generated positive and negative voltage levels alternately turn Q2 on and off. Q2 drives IC2, a quad, bilateral CMOS switch. When Q2 is on, the FSK voltage on pins 2 and 4 of U2 comes from the variable voltage divider connected to pin 3. Conversely, when Q2 is off, the FSK voltage comes from the fixed voltage divider connected to pin 1. These voltages are fed to pad AD@ on the NC20 board. This causes the NorCal 20's frequency to shift in unison with the coded, 5-bit characters. The result is Frequency Shift Keyed RTTY.

INSTALL THE SOFTWARE

Install the HamComm software on your favorite computer and print out the document file, Hc.doc. **Read the**



NorCal 20 with RTTY installed

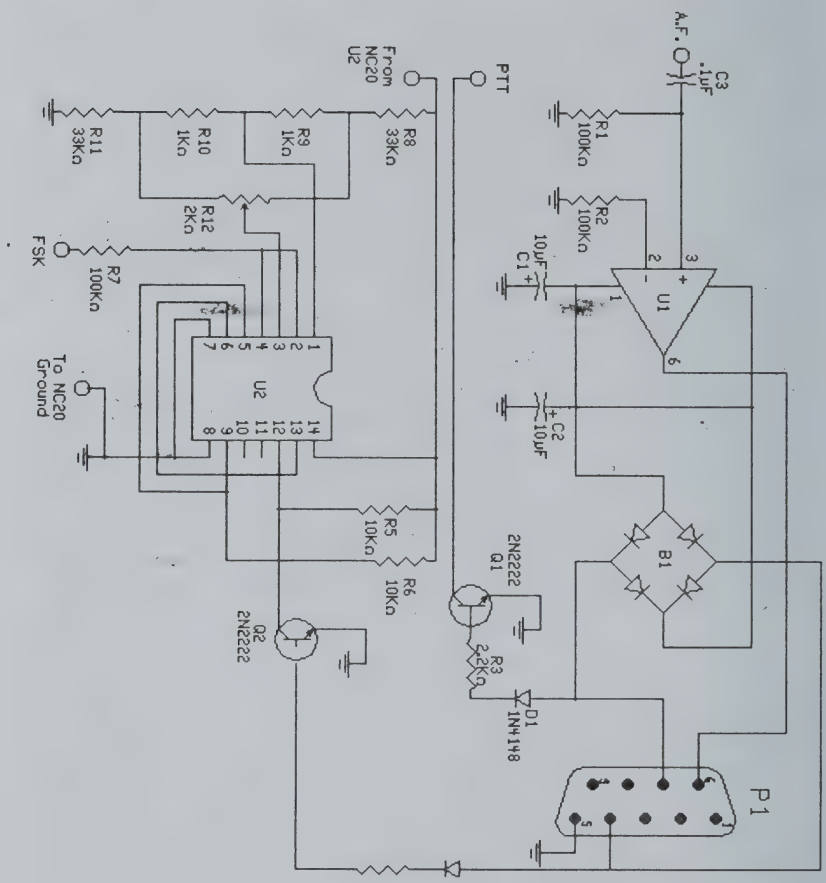
manual from beginning to end. If you're in a hurry, you can safely skip over the parts that talk about AMTOR and NAVTEX, but pay close attention to everything else. After you have gained a fair understanding of what the program does and how it works, modify the configuration file, Hc31.cfg accordingly. Set the center frequency to 725 Hz.

BUILDING THE INTERFACE

I suggest you construct the interface one stage at a time, just as you did with the NorCal 20 itself. Begin with the receive circuit with parts C3, R1, R2, U1, C1, C2, B1 and the DB-9 connector. This part of the circuit is powered by the computer and requires no external batteries or other power supply. Do not install U1, the TL017P just yet.

Test the interface by connecting it to your computer via a suitable serial cable to the Com port you specified in the hc31.cfg file. Run the HamComm software. Measure the voltage between pin 7 of the U1 socket and ground. You should see a positive voltage in the vicinity of 7-12 volts. Next, measure the voltage at pin 4 of the U1 socket. It should be negative and about the same level as on pin 7. Now switch to transmit (CTRL-T) and make sure the polarity does not change at pins seven and four. If everything is okay, shut the computer down and install U1 in its socket.

Connect a wire between the A.F. input on the interface and the rightmost hole of pads AR/C@ on the NorCal 20 main board. Connect a second wire from the interface ground (pin 5 on the DB-9 connector) to a ground pad on the NC20



NorCal 20 RTTY Interface

board. Turn your computer on and run HamComm. Power up your NorCal 20 and search for a strong RTTY signal. Your best bet is to listen between 14.080 and 14.090 MHz. Press the F7 function key on your computer and line up the mark and space tones with the vertical tuning lines on the screen. Press the spacebar to return to the main screen. You should see the decoded text marching across the screen. If all you see is garbage, go to HamComm's KEYING menu and make sure you have selected Normal instead of Reverse.

Once you are printing RTTY signals you can wire up the PTT circuitry. Install D1, R3 and Q1. Connect a wire between the PTT point on the interface to pad K on the NorCal 20 board. Run the program and confirm that pressing CTRL-T keys the transmitter. Pressing CTRL-T again should un-key the transmitter.

The last section of the interface is the FSK generator. Wire it up according to the schematic diagram. Notice

that U2, the CD4066, draws power from the NorCal 20, not the computer like U1. Connect a wire from the +8 pad on the interface to the output pin of voltage regulator U2, the 78L08, on the NorCal 20 PC board. There is no auxiliary pad for this so you will have to solder it to the underneath side of the board. Make sure you select the +8 volt pin, not the +13.8 volt pin. The correct pin is the one closest to capacitor C4. Solder another wire from the FSK output on the interface board to pad D on the NC20 board.

FSK ALIGNMENT

If there is a tricky part to this whole thing, this is it. Alignment consists of, (1) adjusting the NC20's VFO frequency shift to 170 Hz, and (2) adjusting the NC20's transmit offset so that the mark (high) tone is well inside the crystal filter's upper bandwidth limitations. Let's take it one step at a time, beginning with 170 Hz frequency shift adjustment.

If you have a frequency counter capable of measuring audio frequencies you can set the shift by listening to the NorCal 20's transmitter in another receiver. Here's how.

1. Disconnect the serial cable from the computer to the interface.
2. Use a clip lead to connect the junction of D2 and R4 on the interface to ground.
3. Put the transceiver in transmit (into a dummy load) by cycling the TiCK command switch to the "tune" mode.
4. Tune the main station receiver so that the pitch of the NC20's signal is in the neighborhood of 600 Hz.
5. Remove the clip lead from ground and connect it to the +8 volt supply line.
6. Adjust R12 so that the pitch in the station receiver is 170 Hz higher than before.
7. Repeat steps 2 through 6 several times as there is some interaction.

If you don't have an audio frequency counter you can download a software based counter from the Internet at http://www.muenster.de/~welp/sb.htm#analyzer. This software is free but you have to have a sound card in your PC.

Another PC based approach uses a program called Hamview which is available at http://www.freeyellow.com/members/padan/. It also requires a sound card and allows you to see a graphical representation of all the (audio) signals from zero up to 2,048 Hz. The final step is to set the BFO trimmer and transmitter offset in the NorCal 20. You will use HamComm to help you.

Double check the HamComm Hc31.cfg file to confirm that you set the center frequency to 725 Hz. Start the program and press the F7 function key to view the spectrum display. Tune the NC20 to a clear frequency and notice where the noise peaks. Adjust trimmer TC6 so that the upper limit of the noise begins to diminish just beyond about 850 Hz.

Open your NorCal 20 manual to page 15 and follow the procedures to set the transmit frequency offset. The directions suggest you set the offset to about 700 Hz. It would be better to set it closer to 800 Hz to accommodate the 810 Hz mark frequency during RTTY transmit. If you would prefer, you can reset your HamComm center frequency to 625 Hz instead of 725 Hz (in the Hc31.cfg file) in which case you can set the NC20 offset to 710 Hz. If you do

this, don't forget to reset TC6.

THAT'S A WRAP

If you've never operated RTTY before, the ARRL has some good books designed to get you started. Likewise, there are some excellent resources available on the Internet. Back issues of QST can also help.

While the NorCal 20 and HamComm combination doesn't exactly constitute a world class RTTY setup, it is nonetheless a very capable performer. I have worked coast to coast with it and enjoyed many solid ragchews. A quick call to DX stations often results in another country in the log book.

Finally, if you're hesitant to get your feet wet with RTTY you will be pleasantly surprised with the friendly attitude of those who frequent that mode. Like QRPers, they are gentlemen (and ladies). I have never found an RTTYer who wasn't patient and eager to help the neophyte.

Add a new dimension to your QRP operation and go digital. You'll be glad you did.

INTERFACE PARTS LIST

B1	bridge rectifier (Radio Shack 276- xxxx)
C1, C2	10 uFd, 25 volt tantalum
C3	0.1 uf disc ceramic
D1,D2	1N4148 or 1N914
P1	D-Sub, right angle PC mount connector (male)
Q1,Q2	2N2222 TO-92
R1, R2	100k, 1/8 watt carbon
R3,R4	2.2k, 1/8 watt carbon
R5,R6	10k, 1/8 watt carbon
R7	100k, 1/8 watt carbon
R8,R11	33k, 1/8 watt carbon
R9,R10	1k, 1/8 watt carbon
R12	2k, 10-turn PC mount trimpot
U1	TL071P
U2	CD4066

The CMOS III Keyer, A Review

by Jay Bromley, W5JAY
w5jay@alltel.net

Keyers are like keys, they have different levels of price and performance. One class of keyers is one that I like to refer to as the "most bang for the buck". In this class I have would put the Tick Keyers from Embedded Research. I also like the way Brad and Gary show up and support the various hamfest with QRP Vendor booths, and if they can't be there, they always donate prizes. In the ultimate class though, there is one keyer that I love more than the rest. It is the Super Cmos III, from Idiom Press, and that is what this article is about.

The neat thing about using the Super Cmos III is that it is not only feature packed, but it is also very user friendly. Basically there are six push buttons for the various features and one knob to control the speed. The push buttons operate the memories, the command modes and the inquiry modes. One of the things I like most is how easy the memories are to use and setup. Let's say you want to put your call in memory location one (push button 1). You push and hold down the first push button till you hear a tone and then release, you will hear the keyer send C

back to you, which confirms you are in the character mode. In other words, the keyer is now waiting for you to send something to be put in that location. Then you send your call. Afterwards you will hear the keyer sends back to you the letter "I", this is a word space, if you want to keep going.

But in this case we just want our call in that location 1 so after you hear "I" you touch the push button again and now your call is in location 1. If you want to play the message, all you have to do is tap that particular push button. If you push the button 5 times, it will send your call 5 times. You don't have to wait on the keyer to be at a certain point before firing off the next message. It chains its self automatically by how you push the keys. Another example: I have W5JAY in memory location one, 599 in memory location two and AR in memory location 3, I push the first button once, the second button twice and the third button twice. This is what the keyer will play: W5JAY 599 599 AR AR. All this without waiting or using a second function key.

Let's go back to where we sent our call and it added a word space by sending back to us an "I" and was waiting for more input. You could send 599, wait for the "I", then send "AR", wait for the "I", then send "TU". If you make a mistake while sending, it's no problem, send a bunch dits like you would if you were on the air and it will erase the mistake and send the last character before the mistake. Then push the first push button again to close the memory mode. Now if you push the first memory push button it would send W5JAY 599 AR TU. You set it up the way that you want and after playing with it a little you can do it on the fly without any hassle.

There is a real time message mode also, though I rarely use this mode. This is what is so neat about this keyer, its flexibility. It will do most anything you want it to do with minimal fuss. I use my Cmos III in the V0 mode which emulates Super Keyer III timing with dot and dash memory. I also use the autospace function most of the time. However if you like Iambic timing with no dot or dash memory or Curtis A mode timing, all you have to do is push buttons one and two, which puts you in the function mode and sends the character "F". Then send V9 and your keyer is now set up for Iambic timing with no dot or dash memory. If you are wondering what would happen if you send something not in the Cmos III language (i.e. make a mistake on a command), it will send you what they call a "raucous raspberry". This is best described as a buzzing sound to let you know you did the wrong thing and to resend again.

Lets look at another feature, lets say you wanted to reverse from right hand paddle to left hand paddle. You would push buttons two and five simultaneously and the keyer sends back "R" for reverse. No more reversing leads in the middle of field day! Or if another op wants to use your paddles and they are set up backwards for him.

You can put the keyer in tune mode by pushing buttons four and five at the same time. The keyer acknowledges with an "X" and sends a continuous tone. This may also be done by going into the command mode and sending "X" with your paddles. This allows you to use both hands to adjust your tuner. To get out of the "tune" mode, just hit eithe paddle.

I like to go into the inquiry mode

to see what speed the keyer is presently set for. I use this a lot in setting up different paddles. I personally know what my top speed is, and if I can get it close to my bench mark without making mistakes, I know I'm close on key adjustment. To check keyer speed push buttons five and six simultaneously, and it will send a "?" back to you. You then send "S" for speed and it will send back to you at what wpm the keyer is at. You can check the status of all the command modes with the inquiry mode, without changing your present set up.

If you want to check the status of your keyer emulation, press five and six again, (puts you in the inquiry mode) and send "V" after the "?". It will send back to you the emulation your keyer is set at presently, but to change you will need to go into the command mode. You can set the inquiry mode speed range to anything. In other words your keyer could be set at 30 wpm but you may want your keyer in the inquiry mode to send back to you at a slower value like 15 wpm or you could have it follow the keyers speed control. When Chuck comes to town, I make sure all the CMOS III's in the shack track the keyer speed while in the inquiry mode. For some reason, Chuck doesn't like the keyer spitting back something slower than he has set the knob to. In other words if Chuck set the keyer at 35 wpm and asks it a question he wants it coming back to him at 35 wpm.

The CMOS III keyer can be set up as a beacon, and also does contest serial number increments. It has a built in adjustable side tone monitor in which the frequency can be varied, turned on, or off. Speed can go from 5-60 wpm, however default is 5-40 wpm. The ultra speed mode goes up to 990 wpm. Let's see Chuck top that one!! I set my range between 5-35 wpm. When the keyer is set up like this all I have to do is move the knob to the 12:00 position and I know I am around 18-20 wpm. I usually hang here unless I am chasing DX.

The features I mentioned above are about 1/4 of what the keyer is capable of doing. I guess in a way if you consider the features, the Super Cmos III also falls under the "most bang for the buck" keyer.

Even though they manufacturer a ready made unit, I prefer the kit. Mainly because I like to use batteries instead of using a power cord. To me this is an extra lead to get tangled in my already cluttered ham shack. The commercial version that I had, generated a small signal into my 20m receiver that was on USB. This wasn't a problem because it only happened on one frequency and I don't normally run CW while listening in the USB mode. I think the problem is in the non-bypassed three terminal regulator. In one of my Super Cmos III kits, I did the same thing and ran it off a DC supply with a regulator. I had the three terminal regulator bypassed for high and low frequency oscillations and I also had the input and output jacks by passed. There were no ghost signals on 20 meters when I built my kit this way. Also on the commercial version, the push button switches are surface mounted to the circuit board and poke through the cabinet, which always made me wonder how well they would hold up. I also didn't care much for their spongy feel.

Even though I prefer to build my own Cmos III as a kit I would recommend the commercial version. But be warned that you won't get to "custom

ize your keyer, and put in the buttons and arrangements that you like. You will however, get the same keyer.

Here is how I built my kit. I used a Ten-Tec TG-24 case that is the same size as the commercial case. When I received the commercial version and set it next to my kit, I was shocked to learn the case was the same size (cool). I use the Radio Shack Soft Touch Momentary, part No. 275-1566A, for the switches. These are the nicest feeling switches I have come across so far, are easy to use with with my big fat fingers, and I don't make so many mistakes. I also use the mini speaker from Radio Shack part No. 273-092. For the input and output jacks, I use 1/8 inch stereo jacks. I try to minimize having different size plugs on my equipment. I use a battery holder for three AA cells for power. You could probably use lithium or a computer battery, but I prefer the AA's in case I'm in the middle of nowhere and they go bad, replacement is easier. Here is another hint if you roll your own, be sure to put a small tag to record the date when you install your batteries. I try to change mine out once a year because the batteries will start to leak before the keyer quits.

In the past if you wanted one of these keyers you had to mail order it. The service was not good. No person to talk to if there was a problem over a phone. Now all that has changed with Marshall Em at Morse Express handling these fine keyers. Marshall is set up for credit card orders over the Internet or the phone. No more waiting for weeks to find out if your order made it or not. The kit is $55 and he even has a hardware kit for $12 which includes push buttons, pot, RCA jacks, and a three terminal regulator. This is the best $55 bucks you can spend to help you not sound like a novice operator on 160m chasing DX in front of all your peers.

Marshall has built several of these into QRP command consoles. Maybe this is one of Marshall's secrets on being one of the Super Foxes last year. For those that missed hearing Marshall as a fox, you missed a rare treat. He was going three deep at a time, what a show. A lot of operators moved their frequency to the last station worked thinking they would beat the rest out when Marshall had them next up to bat. It sure was fun to see some of the super ops scrambling to remember where they were last. This really wasn't much of a problem though and I think he was one of the top finishers within the allotted time. Was it the CMOS III or Marshall? My bet is on both.

To show how sold I am on the CMOS III, I am using one on my TS-950SDX and my K2. The TS-870S already has one built in, Kenwood calls it a K1 Logic keyer!! It is the same thing with 4 memories instead of six. Both the K2 and the TS-950SDX have built in keyers. Why in the world am I using one of these keyers with a $4000 radio and the ultimate QRP rig, the K2. Bear in mind that I am mainly a headphone operator and any annoyances like pops, clicks, etc. will wear on you during a long contest. By the way none of these rigs are for sale, as each one has it's strengths and weaknesses. I love all these rigs and each rig has a very specific use. I am just trying to show how good the CMOS III keyer is.

Starting with the TS-950. The internal keyer has a reed relay in addition to the amplifier relay. You can turn off the amplifier relay and that helps the

break-in some. There is a menu setting called chatter that I played with some that turned on the chatter suppression circuit, yuck!! Nothing helped much till I went to an outboard CMOS III. Now the TS-950SDX has break-in that rivals any rig (including the TenTecs), even while using the headphones. I can't believe I put up with the internal TS-950 keyer so long.

The K2 is a different story, the break-in is super and the internal keyer is very well behaved. You can go Iambic A or B and left paddle or right paddle just like the Cmos III. When you get to the memory portion of the K2 that is where all comparison ends. The K2 has a function button that must be used in addition to the memory location push buttons. You have to adjust your sending timing when setting up to what you want to playback. Say you have the keyer set to 20 wpm and you load a message in one of the memory locations of the K2. When you playback that message it will be at a different speed that you are sending. You can adjust your sending by trial and error to get the timing right, but I just can't see doing this in the heat of a contest. When you load a message in the CMOS III, it will playback at the same speed and force your timing to be right. I need all the help I can get to sound like I am a better operator.

To be fair to the K2, Wayne Burdick has improved the memory keyer a lot since the Beta test version and now the K2 keyer will allow you to do message chaining. In the Beta Test version you had to use the function button every time to fire a message off and there was no message chaining allowed. What makes it hard to fix is the memory buttons in the K2 do other things in addition to keyer functions. So the K2 for the most part is a two button affair for the memory keyer. To load a message you need to push the function button and then the memory location button. Now to send the message you still have to use function key once and then the memory location of the message you want to fire off. Once the message is going you can push the next memory push button, but not more than one at a time or it will quit.

Wayne says he is at the limits of what he can do software and memory wise. Eric Swartz (Wayne's counterpart at Elecraft) says they may offer an external key pad later to make the keyer easier to use like the CMOS III. If I am going to use something external I think I will stay with something I know, the CMOS III. I am even thinking of putting a CMOS III inside the K2 and use the I/O port for my own key pad. The bottom line is that the K2 built in keyer works fine for casual operating, but does not cut it for a contest situation. I'll use the keyer for ragchews, but when I operate contests, I will opt for the CMOSIII.

I know many of you out there are saying "who uses an outboard keyer these days?"when there are contest programs like NA that do all this and more. Well you are right for the big stay at home contests. But for the field events where you try to cut down on weight and all accessories as possible, a key pad or keyer is another box to carry around. I don't carry my laptop to field events. With the K2 sporting a built in battery, soon to be tuner, SSB, the rig is still a winner at being the ultimate QRP rig even though I may have to carry another box.

Also unless you are pretty experi

enced at chasing DX you are probably very nervous in a pileup and it is easy to make a mistake with no second chances. This is how I was a few years ago on 160 meters. The CMOS III really helped me get in those once in a life time DX expedition logs. It's funny how a person progresses, now I use the memory feature half the time and bang it out the old fashion way the other half. You have to get your confidence up and the CMOS III can help.

I used the TS-870 in the QRP Afield contest and without having to use a function push button I could push the memory keyer buttons without thinking about it. I would fire off sequence of six pushes and while the rig/keyer was doing its thing it left my hands free to do other things. This was my first contest with the 870 and my first contest in a year. There was a learning curve, but it didn't take long because of my past experience with the Cmos III. To me when things are really rolling good during a contest you need to keep everything simple and with the least wasted motion as possible.

The CMOS III makes you a better CW operator on the air whether you are chasing DX or contesting. It can also improve the break-in of a rig like the TS-950. When you have guest ops like over visiting it is very easy to sit them down and let them rip the airwaves up because they have there own CMOS keyer set up just the way that they want it. Just be sure it is in the right mode and the inquiry mode tracks with the keyer, grin.

Try the kit from Morse Express you will be glad you did!! 73 de W5JAY 1. Milestone Technologies, Inc. 2460 S. Moline Way, Aurora, CO 80014-1833 URL: . http://www.MorseX.com email address: n1fn@MorseX.com.

SOME MORE NC20 TWEAKS

by Dave Meacham, W6EMD
206 Frances Lane
Redwood City, CA 94062

These mods are "low key"...no higher TX power, or RX gain, although you may notice the smoother AGC. You WILL be able to take pleasure in the knowledge that your rig is more stable.

1) Change R20 to 4.7k and R29 to 3.9k to make the PIN diodes shut off in a progressive manner.

2) The stock bifilar collector transformer for the PA (Q18) has an open-circuit inductance of 168uH referred to the filter side. This is far more than necessary for that 50-Ohm circuit impedance. It invites self resonance, and PA instability due to the tendency to oscillate at low frequencies. 5 turns bifilar wound on an FT37-61 core gives 5.5uH, or nearly 500 Ohms inductive reactance (ten times the 50-Ohm impedance level). The stability-margin improvement is significant.

3) T3, the collector transformer for Q6, has the same problem in its stock form. Simply rewinding with 5T bifilar spread out over the same core gives 2400 Ohms of inductive reactance referred to the collector side (twelve times the 200-Ohm circuit-impedance level). The result is less chance of core saturation due to DC collector current, less chance of self resonance, and improved stability. 72, Dave, W6EMD
ddm@datatamers.com.

VE3DNL Explains Some Toroid Selection Guides

by Glen Leinweber, VE3DNL
leinwebe@mcmail.cis.McMaster.CA

What prompted Doug to select the cores from the myriad types offered by Amidon? Or why do you see these cores again and again in the circuits we build? First, we should separate the cores into two broad groups, because of two general applications where you'll find them: resonant circuits and broadband transformers. The iron powder cores are best for RF resonant circuits where a coil is resonated with a small capacitor. Iron powdered cores are good here for two major reasons-high Q and low temperature drift.

Broadband transformers require good coupling between windings. That means all the magnetic flux should stay in the core. And "broadband" often means that inherent winding impedance be high, even at low frequencies. So you'll want to have high impedance without too many turns. This requires high permeability that iron powdered cores don't have. High permeability comes at a price: higer losses and lousy temperature stability. Ferrite cores are less useful in resonant circuits because of low Q and temperature drift. And conversely, iron powdered cores are less useful as broadband transformers because not all the flux stays in the core, and you need many, many turns to get reasonably high impedance.

Here's a summary of Doug's choices:

Core	Al(nH/t^2)	Perm	Freq	Tempco
T37-2	5	10	2-30	95ppm
T37-6	3	8	10-50	35ppm
T50-7	4.3	9	3-35	30ppm
T130-2	11	10	2-30	95ppm
FT37-43	420	850	1-50	10000ppm
FT37-61	55.3	125	10-200	1500ppm

"Core" is Amidon's numbering system where "T" denotes toroid, "37" denotes outside diameter, and "2" is the iron powder recipe. "Al" is the winding factor that relates inductance to number of turns. In this case, one turn would give 5 nH. Inductance is proportional to turns-squared, so ten turns would give 100 times as much inductance (0.5uH) and one hundred turns would result in 50 uH. Note that the "Al" values in this table are different than usual - Amidon specs winding factors for iron powdered toroids as "microhenrys-per-100-turns" and ferrites as "millihenrys-per-1000-turns" :-/ In the table above, its "nanohenry-per-turn-squared". "Perm" is relative permeability, which tells how much more the flux lines would prefer going through the core than air. Entirely dependent on the core mix recipe. "Freq." is Amidon's recommendations of useful frequency range for this recipe. Top end is influenced by core losses, bottom end by huge number of turns required.

"Tempco" is the temperature coefficient in parts-per-million per degree ©. I'm guessing that it'd tell how much inductance would change for a one degree (Celcius) change in temperature. Note that tempco actually changes with temperature - these are likely numbers for the region around room temperature. You want low tempco for a VFO coil. The "7" mix has the best, so Doug has chosen to include a T50-7 for use in VFO coils for low drift.

The big T130-2 gives a lot of inductance (Al=11) for use in a tuner. The two T37-2 and T37-6 types are good for general RF tuned circuit use. The two ferrite toroids "FT37" have high permeability which means flux lines stay confined inside the material. This ensures that coupling is very tight between windings - great for broadband transformer use. But losses are quite high resulting in low Q (which gets worse as frequency goes up). If you think "hey, with those nice high Al values, I can get BIG inductance with very few turns - losses should be low", then think again. Core losses are much higher than winding resistance losses and it shows up as low Q.

Look at the tempco - its terrible! These make lousy inductors for critical tuned circuit use, but OK inductors for chokes.

One other thing you have to worry about with ferrite cores is saturation losses. These losses depend on ampere-turns - the product of # turns x current thru those turns. Unlike powdered iron (which are VERY hard to saturate) ferrite cores can only take so much current (AC as well as DC) before getting really non-linear and lossy. Using a FT37-43 core as the collector choke in a 40-meter 5W final amp pushes it close to the limit. Losses show up as heat, so if your core gets hot, you're wasting RF power heating ferrite rather than the ionosphere. You need a bigger core, or one with a higher frequency spec (that'll require more turns).

These ferrites lose their magnetic properties at high temperature. Above the "Curie" temperature of 130 degrees ©, a FTxx-43 core might as well be made of glass - permeability drops to about one. For the FTxx-61 core, Curie temperature is 350 C. For more info, visit Bytemark's AWESOME website: http://www.bytemark.com/amidon or have a look in the HANDBOOK chapter 25.

-Glen VE3DNL

Later, on QRP-L, David Hinerman wrote: *For example, I want to couple a 50-ohm antenna lead to a 2-30 MHz amplifier stage whose input is 200 ohms. If I remember correctly, this requires a 2:1 turns ratio. (Impedance ratio is equal to turns ratio squared, right?) The 200 ohm load is transformed to 50 ohms by the transformer, but the transformer has inductance which appears as a reactance in parallel with the transformed load impedance. (Did I get that part right?) It seems to me I'd want a high reactance. How high is high enough?*

Glen's reply: Dave, OK, in your example, the critical info for # of turns is the 2MHz lower frequency limit, and the 200 ohm load impedance. You want the 200 ohms of load impedance to dominate over the winding impedance. For your parallel model of transformer reactance (in parallel with the 200 ohms) you'd like the transformer reactance to be something like (at least) five times the 200 ohm load. So how many turns

is required to give 200*5 ohms at 2MHz?

Inductive reactance = 2 * PI * F * L
We want to find inductance L that gives 200*5 ohms:
L = 200*5/(2 * PI * 2000000)
L = 79.6 microhenries, or 79600 nanohenries

The Al winding factor for the FT37-43 core is 420 nanohenries per turn-squared. So you need SQRT(79600/420) turns: that's 13.76 turns. No such thing as a fraction of a turn with ferrites, so round up to 14 turns. You could build your 200 ohm to 50 ohm transformer a couple of different ways: One winding of 14 turns for the 200 ohm side, another winding overlaid of 7 turns for the 50 ohm side.

Another way: A bifilar winding of seven turns, which is two separate wires, wound together. Connect the end of one wire to the start of the other. The 200 ohm load goes across the series connected ends, while the 50 ohm source goes between one end and the "center-tap" where the two windings join. This would be OK for unbalanced source and load because one winding connection is common to source and load - that's ground.

This example should be checked up at the 30MHz. End of the range for losses. Up there, the capacitance between wires starts to become an important part of the winding impedance. If your desired frequency range were smaller, you might want to scale up a few turns more than 14:7 so that the 200 ohm load dominates winding reactance even more.

NorCal Toroid Kits Now Available

25 - T37-2 (Red), 25 - T37-6 (Yellow), 25 - FT37-43, 25FT37-61, 25 Ferrite Beads (43 Mix), 10 T50-7 (White) and 1 T130-2 (Red) for $25 plus $4 Shipping US, $6 Shipping DX. To order: Send Check or Money order in US Funds only to:

Jim Cates
3241 Eastwood Rd.
Sacramento, CA 95821

Please include a self addressed mailing label with all orders. Make checks or money orders to Jim Cates, NOT NorCal.

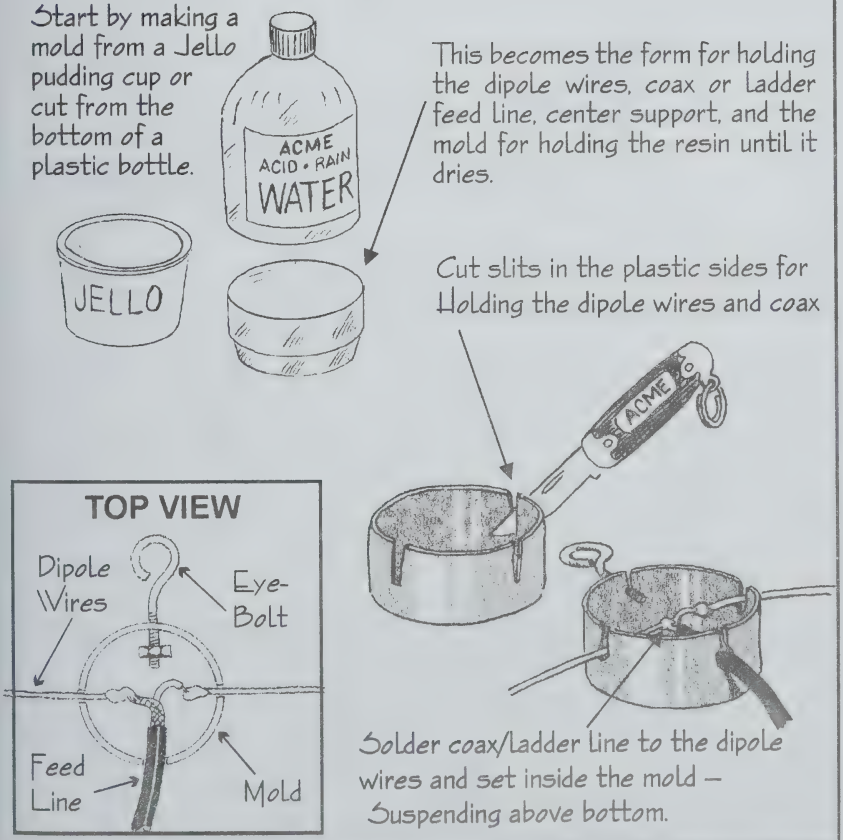
Illustrated by Paul Harden, NA5N

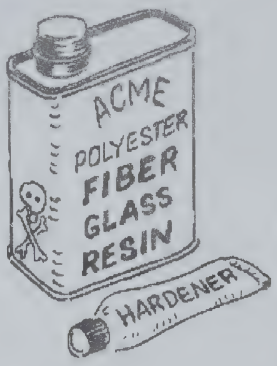
#10 More Neat Antenna Projects

A Bullet-proof Dipole Center Insulator

From Wes Spence, AC5K

I saw this very rugged center insulator at the HamCom building contest in Dallas, and was struck at how virtually indestructable it was, and how it was suitable for "big and heavy" dipoles as well as the light "to the field" QRP dipoles. Wes' antennas, using this technique, has been in the air for years with no sign of breakdown.

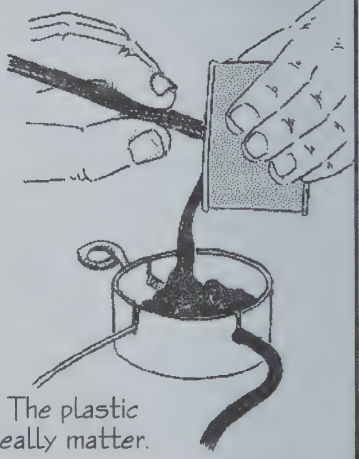

Start by making a mold from a Jello pudding cup or cut from the bottom of a plastic bottle.
ACME
ACID • RAIN
WATER
JELLO
This becomes the form for holding the dipole wires, coax or ladder feed line, center support, and the mold for holding the resin until it dries.
Cut slits in the plastic sides for Holding the dipole wires and coax
ACME
TOP VIEW
Dipole Wires
Eye-Bolt
Feed Line
Mold
Solder coax/ladder line to the dipole wires and set inside the mold – Suspending above bottom.



The "magic ingredient" is a polyester resin – such as "Condo" brand of polyester Fiberglass Resin for performing auto and boat repair. It comes in pint or quart sized cans, with a tube of hardener in the lid (much like 2-part epoxy).

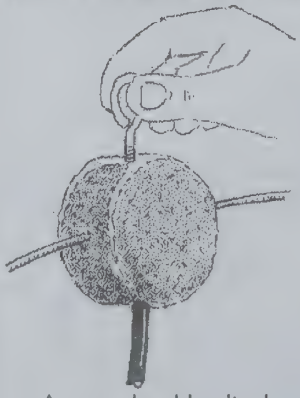
It is recommended to mix the resin in a separate container – not the antenna mold directly. The resin will get hot as You mix the 2-parts together, so use an Appropriate container.

Do NOT use styrofoam!



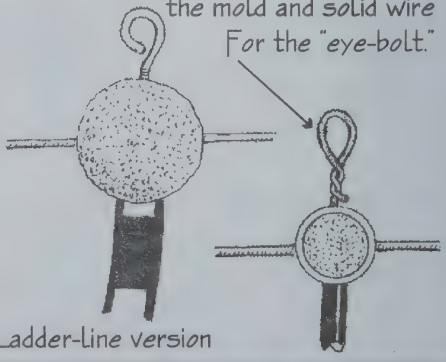
When resin is ready, pour into the mold. Resin should Set hard in about an hour. The plastic form may or may not come off. Doesn't really matter.

THE FINISHED PRODUCT



A very durable dipole center insulator

For a smaller QRP "to the field" dipole, use a plastic bottle cap for the mold and solid wire For the "eye-bolt."



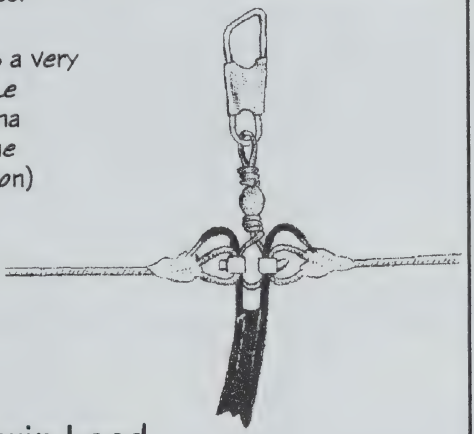
Ladder-line version

The "St. Louis Doublet" Portable Antenna

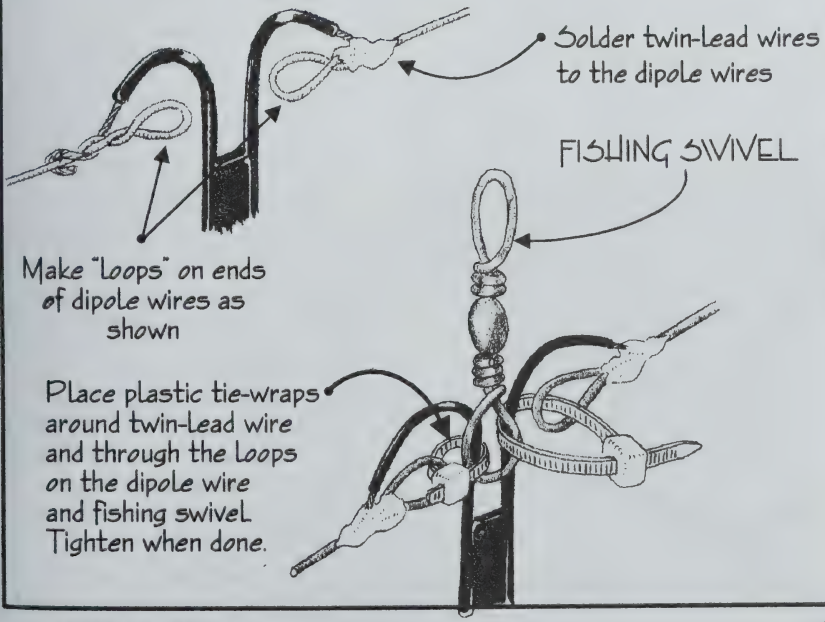
From Dave Gauding, NFØR

Dave Gauding's lightweight portable "St. Louis Doublet" was an article in the Spring 1999 issue of *QRPp*. However, the photo's of the center-fed swivel portion were not detailed enough, prompting many questions as to it's actual construction. The antenna is detailed here by illustrations, which will hopefully make this simple, clever little antenna a cinch to build and use.

The St. Louis Doublet is a very lightweight portable dipole constructed of the antenna wire, feedline, a fishing line swivel and plastic (or nylon) tie-wraps.



Construction using Twin Lead . . .

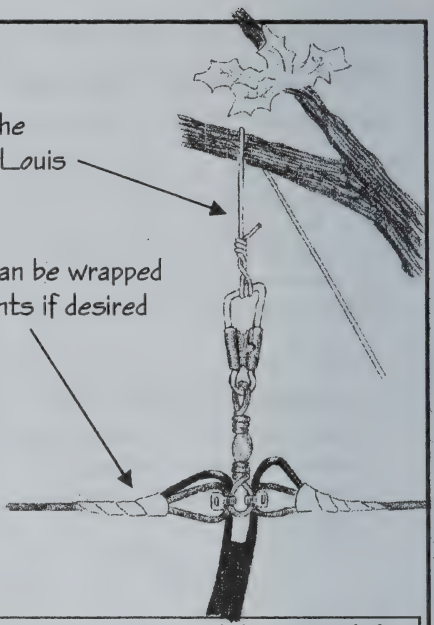

Solder twin-lead wires to the dipole wires
FISHING SWIVEL
Make "loops" on ends of dipole wires as shown
Place plastic tie-wraps around twin-lead wire and through the loops on the dipole wire and fishing swivel. Tighten when done.

Using "in the field"

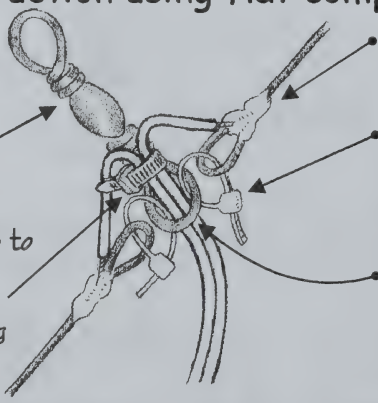
Attach a string or fishing line to the fishing swivel for hoisting the St. Louis Doublet from a mast or tree.

Electrical tape can be wrapped around solder points if desired

Another approach is to use 2-conductor flat computer (ribbon) cable for the feedline (and/or the dipole wire).



Construction using flat computer ribbon cable



Fishing Swivel

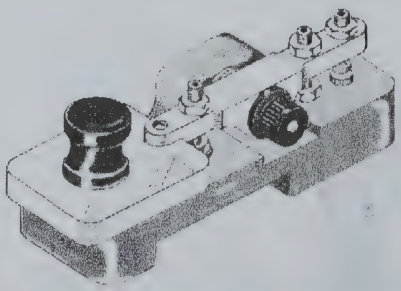
Tie-wrap to secure feedline to fishing swivel

Solder feedline wires to the dipole wires

Connect dipole wires to the fishing swivel with plastic tie-wraps

Route feedline through the loop on the Fishing Swivel as shown to relieve strain from the feedline

Nifty New Straight Key



Doug Hauff's latest creation is a neat, very small straight key that does not need to be held down due to the pivot being perfectly balanced. It is milled out of aluminum and brass, magnetic "spring" and assembled for $44.95 + 5.00 P/H. Available from:

San Luis Machine Shop
200 Suburban Road, #F2
San Luis Obispo, CA 93401

See also the NorCal website

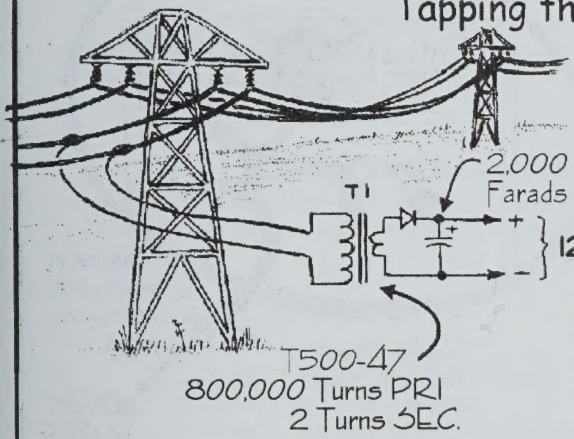
THE QRP Y2K SURVIVAL GUIDE

Illustrated by Paul Harden, NA5N

Emergency Y2K Power Sources

With the electrical power problems expected for Y2K, here's some ideas on keeping your QRP rig powered.

Tapping the "Power Grid"

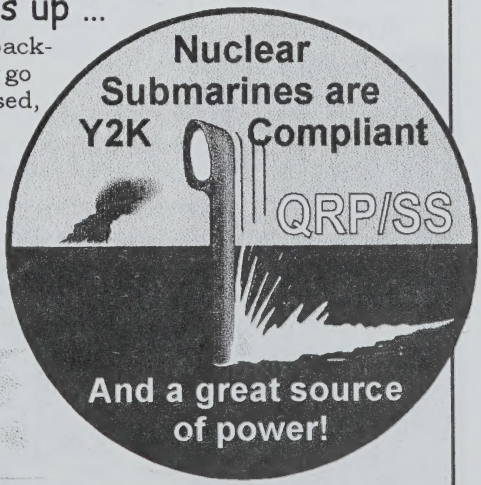


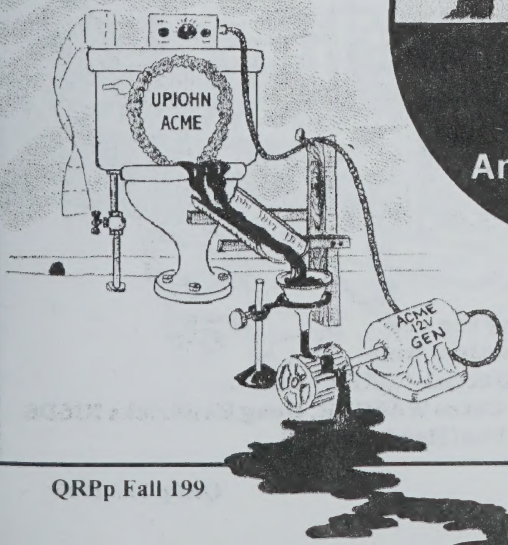
Your local power may be down while it is being rerouted to LA, NYC or someplace.

A simple tap on the high tension lines can provide plenty of power for your QRP rig.

When the sewer backs up ...

When Y2K causes your sewer to back-up, don't let that source of energy go to waste. It can be simply harnessed, as shown here, to drive a squirrel cage 12VDC generator.



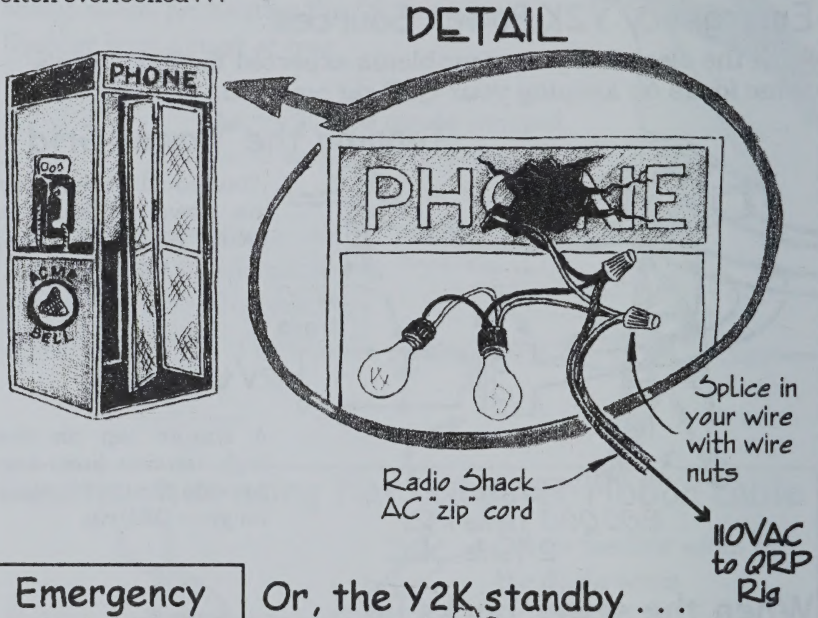


NOTES:

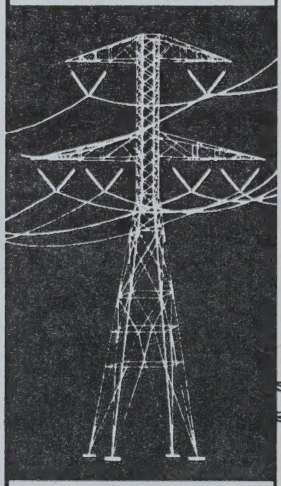
1. Fur-lined toilet seat optional.
2. Recommend you lower the toilet seat when QRP rig is not in use.

More Y2K Emergency Power

Here's another source of emergency power for your QRP rig that is often overlooked . . .



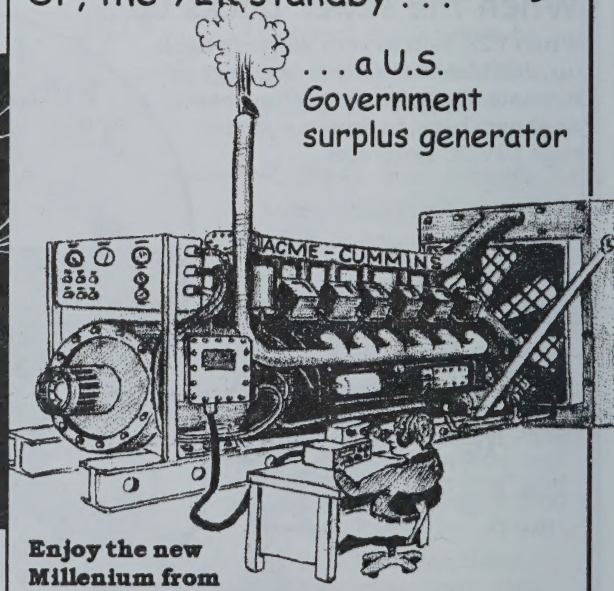
Emergency Antennas



And if your power is out ... you might as well load-up the dead power grid or a radio or cell phone tower.

Or, the Y2K standby . . .

. . . a U.S. Government surplus generator



Enjoy the new Millenium from the NorCal "*QRPp*" staff ... Jim Cates WA6GER, Doug Hendricks KI6DS and Paul Harden NA5N.

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25 - T37-2 (Red), 25 - T37-6 (Yellow), 25 - FT37-43, 25FT37-61, 25 Ferrite Beads (43 Mix), 10 T50-7 (White) and 1 T130-2 (Red) for $25 plus $4 Shipping US, $6 Shipping DX. To order: Send Check or Money order in US Funds only to:

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1993 - $10, 1994 - $15, 1995 - $15, 1996 - $15, 1997 - $15, 1998 - $20 (Avail. Mar. 1, 1999) Full year sets available. NO individual issues available, sets will not be broken.

Shipping: US
$4 for 1 - 3 issues, $5 for 4 - 6 issues.

Shipping: Canada
$4 for 1 issue, $5 for 2 - 3 issues, $7 for 4 -6 issues.

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$5 for 1 issue, $7 for 2 - 3 issues, $10 for 4 - 6 issues

Shipping: DX Pacific Rim, Australia & New Zealand $5 for per issue ordered. All funds US funds only. Make check or money order to Doug Hendricks, NOT NorCal. Please send orders to: Doug Hendricks , 862 Frank Ave. , Dos Palos, CA 93620, USA

QRP Frequency Crystals

NorCal has available the following crystals in HC49U cases for $3 each postage paid in the following frequencies: 7.040 MHz, 7.122 MHz. Send your order and payment in US Funds only to: Doug Hendricks , 862 Frank Ave. , Dos Palos, CA 93620, USA. Make check or money order to Doug Hendricks, NOT NorCal.

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